American Machinist

Volume 65 New York, September 2, 1926 Number 10

Gear Teeth in Action

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WITH this article the second series of twelve articles on gears begins under the title given above. The first series of nineteen articles appeared in previous issues under the title "The Design of Gear Tooth Forms." The third and last series will consider the production of gears.

The relation of errors in the teeth and of the design of the gear blank and the carrier case to noise is first considered, followed by a discussion of lubrication and frictional heat. Tooth loads are studied by graphical representation and by comparison with simple levers. Considerable space is devoted to the solution of load problems in various types of planetary gear systems. The strength of gear teeth is presented first from the point of view of beam strength and then from that of durability. The effects of velocity, material, tooth form, rotating masses, and load on the life of gear teeth are correlated, and the relation of load to wear is analysed. Brief discussions of stress distribution and efficiency end the series.

Eliminating Gear Noise

SATISFACTORY gears must transmit power smoothly, with a minimum of vibration and noise, and must also have a reasonable length of useful life. In order to accomplish these ends, several essential requirements must be met. These requirements are of varying degrees of importance, depending largely upon the service which the gears are to give. Some of them are requirements of the gears themselves, others have to do with their mounting and care in operation.

One word of caution at the outset: No improvement in the design of the tooth forms alone will outweigh the importance of careful and painstaking workmanship in both the production and the mounting of the gears. As a matter of fact, the better tooth forms deserve to receive more care and attention than the poorer forms. A poor design of any mechanism that proves successful is usually a triumph of good workmanship over poor design.

It would be well to state at once that no metal gears in operation are absolutely noiseless. Quietness is a relative term. The most accurate gears when running under load at any appreciable speed will develop a certain amount of sound.

The noise of gears is of many kinds. It ranges from the unobtrusive hum of the better gears to rumbles and squeals of varying pitches and intensities of the poorer grade. The exact cause of all conditions of noise are not, as yet, fully known. One fact, however, is certain: excessive noise is evidence of improper conditions somewhere in the mechanism. In many respects it is not a matter of why gears are noisy but rather why they are ever quiet. Certain types of defects in the gears, however, develop certain characteristic noises.

Noise in relation to uniformity of profiles and spacing, to eccentricity, and to smoothness of surface—"The Music of the Gears"—Relation of musical note to gear-tooth combinations—Resonance and dissonance

Noise is relative rather than absolute. It may be defined as a unpleasant or objectionable sound. This is certainly a proper definition of the noise of gears. There is only one sure method of reducing the amount of sound produced by gears. That is to increase the accuracy and smoothness of profile in the production of the gears. More favorable gear tooth forms may help some, but this improved design must be coupled with high-class workmanship in order to secure the best results.

The search has been made for many years, and still continues, for some form of modification of gear tooth profiles that will obviate the need of extreme accuracy. This search has been fruitless in the past, and probably always will be. If such a modified form were discovered, it probably would also be found that the forming of this modification must be done with great accuracy, and that the spacing of the teeth must be as nearly perfect as on other forms to secure quiet running, while the difficulties of control would be even greater than at present. This does not mean that all modifications of gear tooth profiles are always undesirable. Certain slight modifications can be made to advantage at times that tend to minimize the effects of other small errors. The attempt should always be made to keep such modifications to a minimum. In most cases, this modification should be in the nature of a tolerance; that is, the direction of permissible errors on the tooth profiles should be in the direction that avoids edge contact at the beginning of mesh. The

idea that if a little modification is good, more is better, does not prove out in practice.

Four general characteristic sounds are produced by gear teeth in operation under load. One is an intermittent clicking or steady growl caused by poor spacing or irregularly-formed tooth profiles. The second is a pulsating growl or run-out sound caused by eccentricity of the gears. The third is a high-pitched squeal caused by rough tooth surfaces. The only remedy for all these three is better workmanship. The fourth sound is a tone that depends upon the pitch and speed of the gears. This sound approaches a musical tone with the higher pitch line velocities, the pitch of this tone depending upon the number of tooth engagements per second. If this tone is steady, it indicates uniformity in the gear tooth profiles. If it varies in intensity it is evidence of a variation in the meshing conditions. Such variations may be caused by faulty tooth profiles or spacing, variation in the load transmitted, or springing of the gear shafts under the load, and the like.

Uniformity of Tooth Profiles and Spacing

It is evident that in order to secure smooth transmission of power by means of gear teeth, both the profiles and the spacing of the teeth must be accurate. Gear teeth are nothing more than cams acting against each other. An error in either the form or position of these cams will cause a change of greater or less amount in the velocity of the driven gear. This change will occur in a very short space of time as the inaccurate teeth come into contact. The greater the speed of the gears, the shorter the time in which this change will take place.

Such variations in the uniformity of the motion transmitted will develop noises of varying kinds and intensities, depending upon the nature and extent of the error. Practically all gears are made with a certain amount of backlash between each tooth and the corresponding space on the mating gear. Too great an error in the profile will cause an intermittent metallic rattle as the momentum of the driven gear, when speeded up by a faulty profile, throws the non-active profile of its tooth against the non-active profile of the tooth in the driving gear. This condition is particularly noticeable when the gears are running idle or under but slight loads. Such errors in the gear tooth profiles are also serious as regards the strength and wear of the gear teeth. Correct profiles, both as to form and spacing, are of even more importance for strength and long wear than they are as for quiet running. There are many cases where the noise is of secondary importance, but there are few places where strength and durability are not of primary importance.

On involute gears, an error in either the tooth profile or spacing will make a difference in the normal pitch. This normal pitch should be uniform on any gear and it should be identical on mating gears if the most satisfactory results are to be obtained. If the normal pitch on each gear is uniform, but the normal pitch on one gear is not identical with that of its mating gear, a steady growl will be heard, the pitch of the sound being dependent upon the speed of the gears and its intensity upon the extent of the difference. If this normal pitch is irregular, a grumble of varying intensity will develop. This last sound is one of the most disagreeable of gear noises.

Even with the greatest care, some inaccuracies will always be present. The second best thing to absence of all errors is to have such errors as are unavoidable of such a nature that they cause the least annoyance. Edge contact at the beginning of mesh is always dangerous. It not only causes a sudden change in velocity with the attendent noise but also tends to gouge out the profile of the mating tooth. Therefore, whatever departure from theoretically correct profiles is present should be in a direction that will avoid edge contact at the beginning of mesh. To accomplish this end requires a modification of the theoretical profile. The amount of such modification is dependent upon the extent of the errors that may be present. This modification may be secured in either one of two ways: First, the tip of the profile of the tooth of the driving gear may be cut back slightly, or "eased off"; or second, the normal pitch of the driving gear may be made slightly greater than that of the driven gear. When a normal pitch difference is used for this purpose, the amount of difference should be used as a tolerance. Both gears should have the same basic normal pitch, but the tolerance on the length of the normal pitch of the driving gear would be plus while the tolerance for the driven gear would be minus.

The base circle of the involute profiles should be concentric with the center on which the gear actually operates. This is a matter that requires great care while the gears are being cut. It is good practice to true the outside diameters of gear blanks by turning or grinding on an arbor before cutting the teeth so that the concentricity of the set-up for cutting the teeth can be accurately checked. This outside diameter of itself is but of little importance. It is, however, the most convenient, and therefore the most important reference surface for securing concentricity of gear tooth profiles.

An eccentric gear develops a sound of rising and falling intensity, which is readily distinguished from the other noises. This noise is usually a disagreeable one. Not only the noise is objectionable, but also the irregular motion transmitted by eccentric gears is seldom desirable.

Effect of Eccentricity on Gear Noises

An analysis of the action of purely eccentric involute gears with large or small eccentricities shows that they will give a varying but continuous action. Each succeeding tooth takes over the load from the preceding one smoothly without a blow. With uniform motion of the driving gear, the velocity of the driven gear will vary according to a pure sine curve. It is not an intermittent action such as develops from spacing errors. Thus the eccentricity of accurate involute gears does not introduce the effect of spacing errors, and has but relatively little effect on the strength of the gears because the accelerations caused by such eccentricity takes place in a relatively long length of time. Eccentricity of gears is therefore objectionable primarily because of the resulting varying sound in operation and of the irregular motion transmitted, particularly if they be change gears.

This smoothness of action of eccentric gears requires a sufficiently long arc of contact to secure an overlap at all positions of mesh and also a large enough tooth load to keep the teeth of the two gears in contact. Otherwise a rattling noise will also be present in addition to the characteristic run-out sound.

Eccentricity is extremely objectionable on change gears used for accurate dividing or screw cutting. Even

very small eccentricities have a very marked effect on the accuracy of the final result. Particular pains should always be taken in the cutting of change gears to keep the amount of eccentricity to a minimum.

For quiet operation, it is most essential that the surfaces of the tooth profiles of the gears be as smooth as it is possible to make them. A roughness on these profiles that is hardly noticeable to the eye will develop considerable noise when the gears are run under load at any appreciable speed. The sound caused by rough tooth profiles is a distinctive high-pitched scream which varies in its intensity more than in the pitch of the tone as the speed and load is increased. This sound is very penetrating and hence is all the more objectionable.

Rough surfaces on gear tooth profiles not only are detrimental to quiet operation but also are responsible for rapid wear. When this roughness is very slight, it sometimes smooths down in a short time, when the gears are operated under load, without any appreciable wear taking place so that much of this noise is eliminated. The amount of the roughness that can be eliminated in this manner, however, is slight. If it is excessive, the accuracy of the tooth profiles will have been destroyed by wear, resulting in greater profile and spacing errors with all their objectionable features, before the tooth profiles became smoothed down. In other cases this original roughness is never eliminated, but rather gets worse with time and wear. This condition seems to be particularly true when two soft steel gears run together. The nature of this material is such that it seems to abrade and rough up rather than polish down.

"The Music of the Gears"

Several years ago the writer was discussing various gear problems with Charles H. Logue, and the discussion turned to the subject of the musical tones in the sounds produced by gears. Most of the following material on this subject is taken from notes furnished the writer by Mr. Logue.

The extent to which the science of musical sounds may enter into machine design is but slightly appreciated. A successful engineer or mechanic has a certain instinct in this direction—he must have—but it does not appear that any definite connection is generally recognized. While the study both of dynamics and of sound are included under the same general heading—Physics—it seems in practice a far cry from the study of machine design, for instance, to the study of music. Nevertheless there is a close connection.

"The distinction between music and noise is, generally speaking, a distinction between the agreeable and the disagreeable."

For commercial gear drives, where all noise cannot be eliminated, there is a demand for some degree of quietness; that is, what sound is present should be unnoticeable or agreeable. These less noticeable sounds are generally found in the lower pitches or tones. In usual gear design the attempt is made at times to reach pitches so high that they are indistinguishable. The usual results are poor, although there are installations where it is good practice.

Noise in the operation of gears is caused primarily by errors in individual tooth action. The ear is capable of hearing sounds arising from 32 to 38,000 vibrations per second. Thus when the number of tooth engagements per second exceeds 32, the result is a continuous noise which may be recognized as a tone whose note or vibration period is designated by the number of tooth engagements made per second. In case these vibrations should exceed 38,000 per second, no tone would be heard from this cause, but such speeds are beyond the ordinary range of gear practice. This may tend to explain, however, why gear units that are capable of running quietly at a speed of 5,000 ft. per min. may be raised to any higher practical speed, say 8,000 to 12,000 ft. per min., without additional noise.

The starting point of the musical scale, that is, the number of vibrations per second for the key note, is entirely a matter of convention. In practice there is a great lack of agreement. The ratios between the various tones, however, are constant regardless of the exact number of vibrations per second selected as the starting point. The arbitrary scale of pitch in common use, and typified by the white keys of a piano, is represented by the following ratios, which are also very close to the actual number of vibrations per second ordinarily used:

Note	Frequency
c	128.0
d	144.0
e	160.0
f	170.6
g	192.0
a	213.3
b	240.0
c′	256.0
d′	288.0
e′	320.0
f′	341.3
g′	384.0
a′	426.6
b′	480.0
c″	512.0

Thus, if a pair of gears revolved at such a speed that 256 tooth contacts were made each second, the pitch of the sound would be approximately that of middle c on the keyboard of a piano.

Resonance

When we are dealing with a single pair of gears, this study is primarily one of resonance, the gears being the generator or source of the vibrations, and the carrier or case containing the gears the resonator. We have also to consider the natural tone frequency of the gears themselves. This will be considered later when we discuss the gear blanks. If the case containing the gears has a natural tone frequency of say 256 vibrations per second, it will respond to the tone of the gears when their speed is such that the number of contacts made by the gear teeth per second is 256, or in that neighborhood. If the tone frequency of either of the gear blanks has this same natural frequency, this will also tend to enlarge upon the sound produced. Under these conditions, the case containing the gears becomes an amplifier so that the result is a far greater volume of sound than originally started from the gear teeth themselves. It should be understood that the resonator can produce no noise which does not originate from some other source, in this example the gears themselves. The study of violin construction resolves itself into the production of a resonator (violin body) that will respond equally to all tones. The ideal gear

case would be one that would not respond to any tone.

When two or more pairs of gears are engaged, we have to consider consonance in addition to the study of resonance. The combination of tones produced by the various gears may be discordant or harmonious according to the ratio of their tone frequencies to each other. In general, the difference between consonance and dissonance, or between harmony and discord, or between music and noise, is that noise is unpleasant or irritating while music is heard either with pleasure or with indifference. Musical tone combinations are of course to be desired, as they are not only more pleasing, or softer, but they are also more rapidly blanketed or dissipated.

Harmonious Ratios

The general law governing consonance and dissonance, as stated by Dr. Helmholtz, in his *Sensations of Tone* is simplicity itself: "Generally those tones, and only those tones, harmonize whose fundamental tones bear to one another ratios expressed by small numbers; and the smaller the numbers which express the ratios of vibrations, the more perfect is the harmony of the two sounds."

For example, the following ratios give pleasing combinations of tones:

Ratio	Tone Interval
1:1	Single tone
1:2	Octave
1:3	Octave and perfect fifth
1:4	Two octaves
1:5	Two octaves and major third
1:6	Two octaves and perfect fifth
2:3	Perfect fifth
2:5	Octave and major third
3:4	Perfect fourth
3:5	Major sixth
4:5	Major third
5:6	Minor third

Except when the ratio gives an even octave, such as 1:8, three octaves; 1:16, four octaves, etc., when the figure that expresses the exact ratio becomes larger than 6, we begin to run into discords. For example, 8:9 is a major second, and is more discordant than harmonious.

For a definite example, we will consider the gears in an automobile transmission case. All of the gears on the countershaft make the same number of revolutions. The combination of tones that result from the tooth engagements of any two pairs of gears in such a case will have a frequency ratio the same as the ratio of the numbers of teeth in the gears on the countershaft. By keeping the numbers of teeth in these gears to harmonious ratios we can avoid certain unpleasant sounds. For example, if the constant-mesh gear has 30 teeth and the second-speed countershaft gear has 25 teeth, the ratio will be 5:6 and their combined sound will produce a minor third. If the second speed gear has 24 teeth, the ratio will be 4:5 and their combined tone will produce a major third. Both of these combinations are harmonious. The low-speed gear could have 15 teeth which would give a ratio of 1:2, or an octave tone interval, while the reverse gear could have 12 teeth which would give a ratio of 2:5 and a tone interval of an octave and a major third.

Some European automobile transmissions are now made with all of the gears on the countershaft with the same number of teeth, changing the pitch of the gears to secure the desired reduction ratios, in order to have but a single tone due to the tooth engagements. It is also of interest to note in this connection that the easiest transmission in the writer's experience to keep quiet was one in which the tooth numbers on three of the four countershaft gears gave ratios corresponding to harmonious combinations; and also that the most difficult one to deal with had tooth numbers that gave ratios of very discordant combinations of sound. The tooth numbers alone were not entirely responsible in either case, but they were unquestionably important contributing factors.

Loudness depends upon the amplitude of vibrations, density of the medium in which the vibrations are created, and upon distance. With gears, the amplitude will depend primarily upon the error in pitch velocity; that is, approximately upon the percentage of error; the medium and the distance are factors over which we have little or no control.

An equal volume of sound may be produced by two pairs of gears, one having a low pitch with high amplitude and the second pair having a high pitch with low amplitude. It then becomes a question of which is the least objectionable, or upon the ability of the installation to cover up or blanket the sound. Of the two, the first is the easiest to muffle; high notes are more penetrating.

In case the gears are made for machine tool drives, the high-pitched gears are often preferable despite the character of the sound because each vibration is usually plainly distinguishable as "gear tooth marks" on the piece being machined. Each installation has its own peculiar problems in this respect.

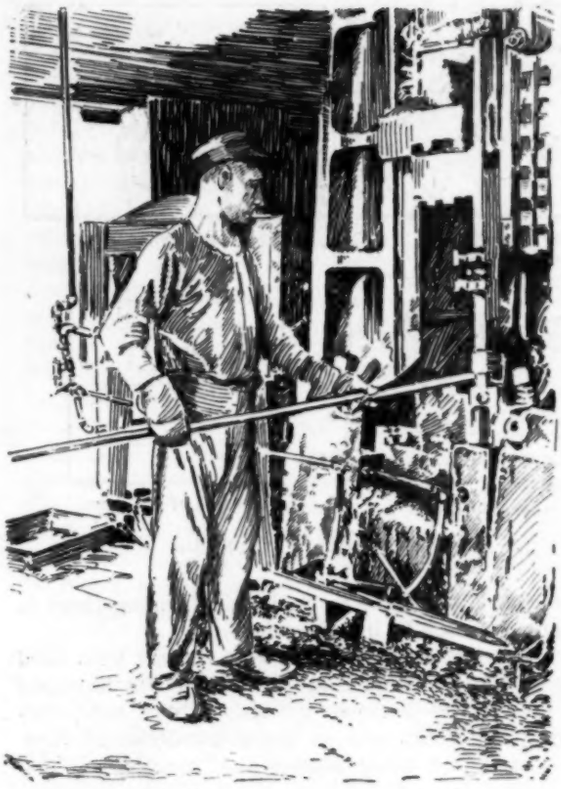
A distinction must be made between the smoothness of operation and the noise of operation. A fine circular pitch may increase the smoothness of operation but it may also increase the noise of operation. The answer lies in the relative accuracy and tooth design.

Designing With Freedom

By G. B. Stuart

How many times is the designer handed a new job with a warning, "something like that, but stick to our standards"? Then when his design begins to take shape with new features incorporated down comes the chief, the production superintendent, and some others with their ideas already fixed by what they consider limiting conditions in the shop. This applies to the design of the salable product of the factory as well as to the equipment to manufacture it. A continued demand for something newer and better by the buyers helped to advance automobile design, but no such condition has to be met in many machine shops.

All kinds of arguments have been advanced to condemn the idea of having the executive offices of the factory in another city, but it seems to me that here is one argument in favor. The detached executive office will not know the limits of the shop milling machine or the fact that foreman Bill Smith favors one kind of steel. Put the designers in the executive office where they can view conditions, but not be overbalanced by them. Naturally the shop will seek the most convenient method if left to itself, but if it is given a job that it knows it cannot change without substantial arguments, it will "produce the goods."



An Outline of the Methods Used in Forging Brass

By Frank W. Curtis
Western Editor, *American Machinist*

Characteristics of metal and shapes that can be forged—Temperatures necessary for best results—Types of dies—Important points to be considered

BRASS forging, while not recent in origin, has been used for commercial purposes only a short time. Rapid progress has been made in this art during the past five years and, today, a wide variety of shapes is being produced successfully. At present, the majority of brass forgings are made by concerns that specialize in this class of work, although many manufacturers make such forgings as will fulfill their own requirements. There are some articles that cannot be forged, due to their intricate shapes, but this condition is true in steel forging as well where difficult work is often encountered, in which case a modified design is found necessary. As a rule, brass forgings do not run as large in size as do steel forgings, and the only determination as to whether or not a piece can be forged is largely dependent on judgment. From the examples illustrated, a comprehensive idea of the possibilities can be determined. The data and illustrations shown were obtained from the Chicago Forging & Manufacturing Co., Chicago, Illinois.

In reality, the process of making brass forgings is divided in two classes. One method is similar to that used for steel work, in that the forgings are made from heated bar-stock, ranging from 3 to 5 ft. in length. On smaller work three or four forgings can be produced with one heating of the bar, but on larger work the bar must be heated after each operation. The other method consists of squeezing a heated slug between dies that cause the metal to flow sufficiently to fill the die impressions. This method is preferred when the work is cup shaped and contains bosses or raised portions inside the cup, or when the cup is deep.

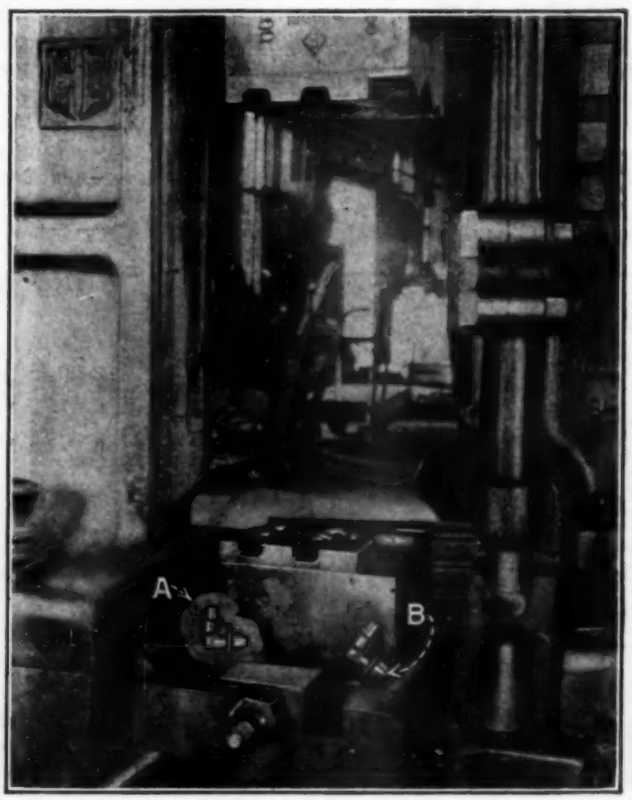


Fig. 1—Die used for making brass elbow

Power presses and drop hammers both are used in making brass forgings. For work having little draft and deep impressions, the press is generally used, but for larger work, and parts that are irregular in shape, the drop hammer is preferred. The size of the work in relation to the hammer is important and, contrary to general imagination, the relative sizes do not run in proportion. The thickness of section of the work being forged determines the size of the hammer, and the governing factor is to deliver a blow sufficiently bal-

anced to form the shape required, yet the blow should not be so rapid that the metal is not given time to flow. In many cases, an operation is routed for a hammer of a certain capacity, and apparently it would be satisfactory if the metal being forged were steel, but the peculiarities of brass are such that the pressure of the blow and the rapidity with which the metal is struck must be tried. Experience, however, will dictate the proper hammer for a given piece of work.

There are many advantages to be gained in die-forging brass to shape, the two outstanding features being strength and uniformity. As in other metals, when brass is forged to shape, it has a closer grain and greater strength. In many cases, the greater strength obtained permits a reduction in the weight required for a given piece of work. It is possible in some shapes to hold brass forgings to a limit as low as ± 0.002 or

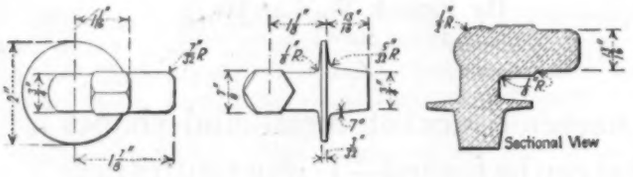


Fig. 2—Details of elbow

0.003 in., and regularly to ± 0.007 in., and to eliminate flaws and pores such as are usually present in castings. The outer surface of a brass forging is smooth and free from scale, and its uniformity insures better chucking facilities, therefore, a smaller amount of material is necessary on dimensions that require finishing. One point to be considered in estimating the weight of a forging is that the average flash of a brass forging is approximately 30 per cent of its total weight.

Well-Made Forgings are Leak Proof

In work that requires to be leak proof, such as high-pressure steam fittings, forging offers a satisfactory solution. When castings leak, the general tendency is to make them heavier in proportion to their size, so that additional weight is required. If a forging is made properly, however, there is little chance of leakage. Brass castings are subjected to a rejection loss that often runs as high as 50 per cent or more in accordance

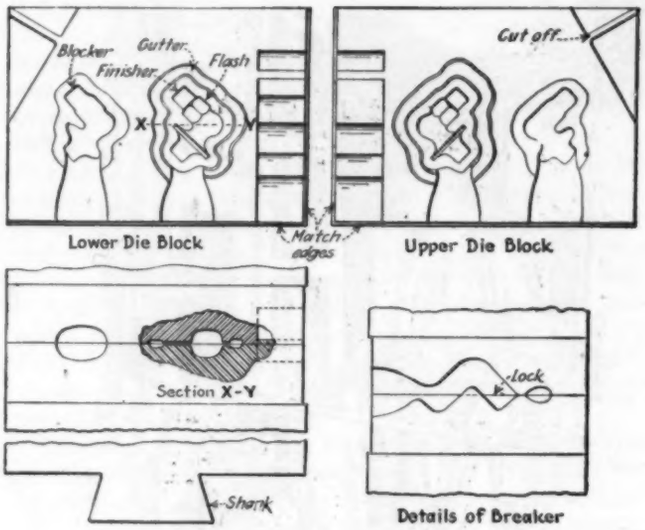


Fig. 3—Details of elbow die

with the character of the work, but in forging there is seldom any loss due to imperfections.

Since brass forgings do not come in contact with sand in their making, the cutting tools used for finishing have a longer life between grinds. There are other advantages apparent, such as the possibilities of forging hexagonal and other shapes that require no machining.

The following important points are to be considered in making brass forgings:

Material—It is necessary to use the proper material. The chemical analysis is not as important as the grade of the bar. Rolled brass-rods have a tough skin that is detrimental in making forgings. The skin portion forms the outer surface of the forging and, as a rule, it develops cracks. Brass rods extruded, and without any additional rolling or annealing operations, form the most satisfactory material for producing forgings. An alloy consisting of 60 per cent copper and 40 per cent zinc, together with traces of lead and other constituents, is used generally for forging purposes.

Style of Dies—Dies used in forging brass closely resemble those used for steel-forging operations. When forgings are made from bar stock, the dies should usu-

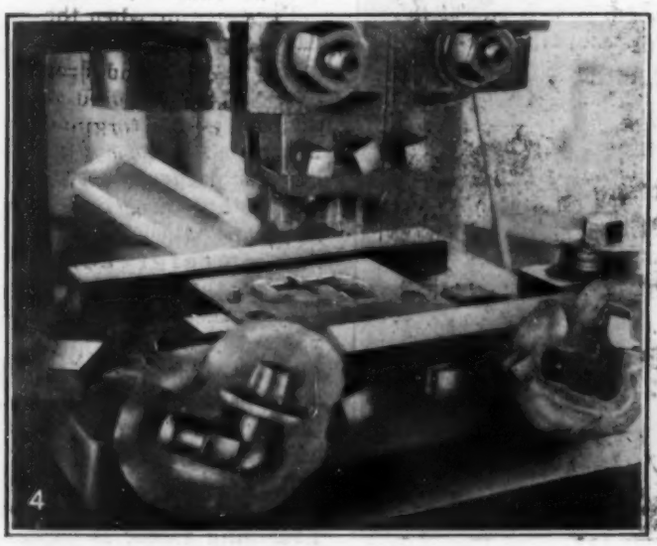


Fig. 4—Die used for trimming elbow

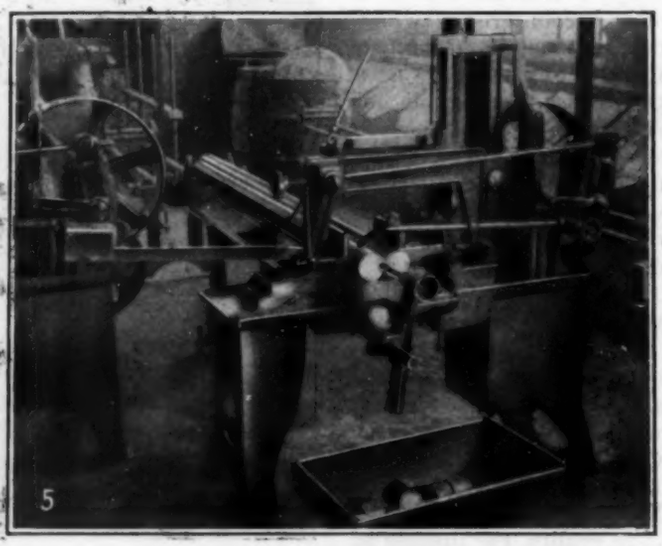


Fig. 5—Cutting off slugs

ally contain a breaker, a blocker, and a finishing impression. On some shapes, however, the breaker or blocker can be eliminated, notably when slugs are used in place of bars. In either case, a draft of from 3 to 10 deg. is required depending on the depth of the impression. When a forging is to have a boss or deep impression, the deepest impression is usually made in the upper die-block, since the metal has a tendency to flow upward. In forging small work under a hammer, the dies often have multiple impressions of similar shape, as many as six being practical. A good grade of tool steel should be used for making dies for press work while for hammer dies a good die-block steel is satisfactory.

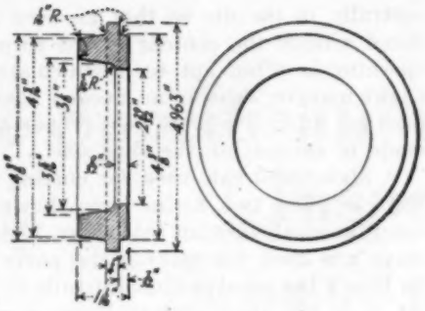


Fig. 6—Detailed drawing of a forging made from a slug

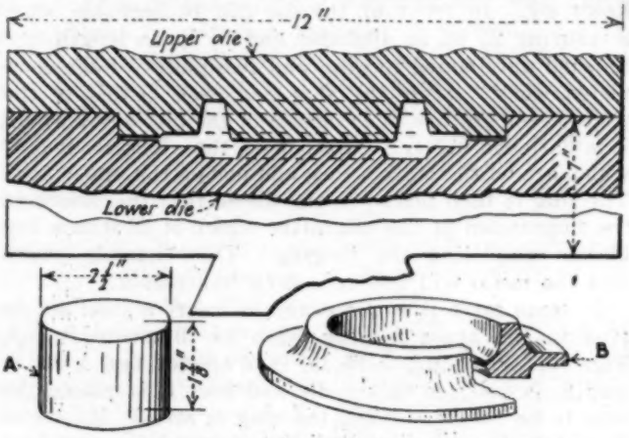


Fig. 7—Constructional details of die used for slug forging

Forging Temperature—Brass is forged at a temperature ranging from 1,150 to 1,300 deg. F. If the metal is worked below the proper temperature it will not flow properly and has a tendency to crack and produce unsatisfactory results. On the other hand, if the proper temperature is exceeded, the metal will crumble and produce an inferior forging.

Heating the Dies—Before the dies are placed in service, it is necessary to heat them thoroughly. If an attempt is made to forge work with cold dies, the result will be similar to that obtained when the metal being forged is below the proper temperature. A satisfactory way to heat the dies is to insert a heated bar or plate between them and leave it there for a period of 15 or 20 min. before the dies are placed in service.

Lubricant—It is necessary to lubricate the dies used in making brass forgings, as is the practice for other metals, but precaution should be taken to lubricate the upper die only. When the lower die is lubricated, the heated metal forms a gas that causes unfilled forgings and inferior work. Machine oil or soluble oil is applied with a swab.

Forgings from the Bar—In cases where two or three forgings are to be made from a single heat, after the first forging has been cut off, the end of the bar frequently is subject to cracking, produced by the cut off of the die. In making the second forging, it is necessary to make provision for this cracking by allowing a sufficient amount of stock on the end of the bar. If this practice is not followed, the succeeding forging will develop a crack that spreads through the portion of the work made from the end of the bar. In forging work from bar stock when the use of a breaker and a roughing impression are required, it is necessary to roll or rotate the bar a full 90 deg. in order to avoid folds.

The furnace used in connection with brass-forging work should not be used for any other purpose if a uniform product is required. If steel is heated in the same furnace at the same time, the brass has a tendency to absorb some of the carbon contained in the steel, with the result that the forging will develop hard spots.

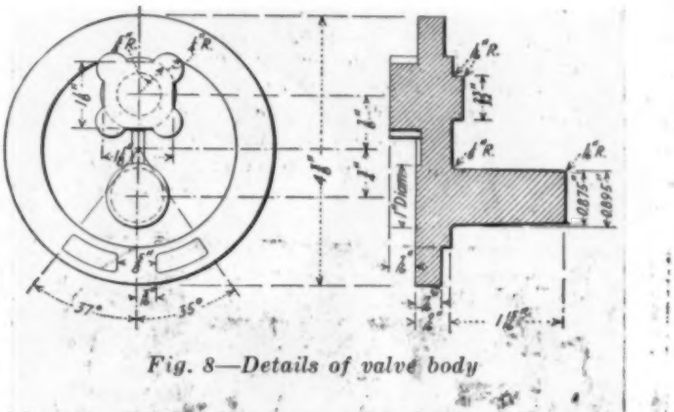


Fig. 8—Details of valve body

After the forging has been polished the carbon spots will be visible and they will not take so high a polish. If the furnace is first used for steel and afterward for brass, the same condition exists, although the effect is not so marked. Carbon has a tendency to soak into the brick lining of the furnace and it will be absorbed by the brass for several hours after the change has been made. For this reason, it is advisable to use the furnace exclusively for brass. Gas- or oil-fired, or electrically-heated furnaces are suitable for heating purposes.

Vibration caused by the hammer or the press has a tendency to shake the furnace so that small particles of brick will fall on the brass being heated. These

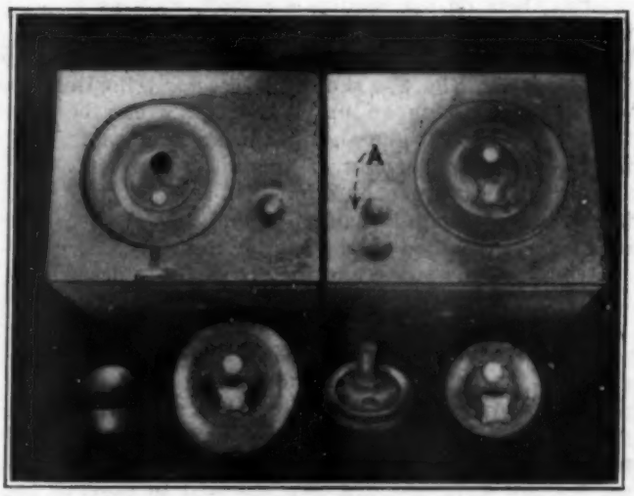


Fig. 9—Die used for making valve body

particles imbed themselves in the brass in forging, and cause small deposits that will be visible when the work is polished. To avoid this condition, the furnace should be mounted on a solid foundation independent of that used for the presses or hammers whenever possible, and should be equipped with some form of shock absorber. Vibration can be partly eliminated by cork placed under the furnace legs, or by the use of air or spring cushions. Cork, however, has a tendency to pack and has to be changed often, so that the other methods are preferred.

An example of a brass-forging die for an elbow, mounted in an 800-lb. drop hammer, is shown in Fig. 1, in which a piece as forged is shown at *A*, and after being trimmed, at *B*. In Fig. 2 is shown some work as forged, while in Fig. 3 the constructional details of the die are given. The heated bar is placed on the breaker where it is given one blow to form the approximate

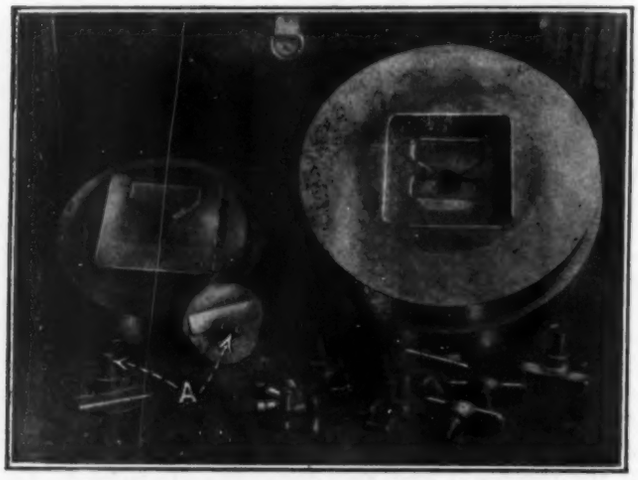


Fig. 10—Die used for inserting steel studs

outline of the work. Then it is placed on the blocking impression where it is struck three blows to shape the forging roughly. From here it is transferred to the finisher and receives three blows to complete the forging. The forging is severed from the bar by the cut-off provided at the rear corner of the die, after which the operations are duplicated for the succeeding piece. In some hammers a shear knife is provided and the dies used in them do not require a cut-off, such as is used in this die. The material for the forging is $\frac{11}{16}$ in. in diameter. An average of three pieces are made from each heat. In Fig. 4 is shown the die for trimming the work and in which an untrimmed piece can be seen resting against the die shoe. The untrimmed forging is placed in the opening of the die and then forced through it by the punch. Split dies are generally used to facilitate machining of the contour. A clearance of $\frac{1}{2}$ deg. is provided on the wall of the die. The clearance between the punch and the die varies in accordance to the thickness of the flash to be cut off.

When slugs are used to produce forgings it is important to have them correct in size, so that the impression in the die will be filled and a proper flash produced. In cutting slugs from bar stock, the faces must be square with the bar so that they will stand perpendicularly in the die. It is advisable to try various-sized slugs when using a new die and to observe the comparative results to determine the best size of slug for a given component. The slug should be placed centrally in the die so that an even flash will be produced around the contour of the forged shape, but the operator is often apt to miscalculate the center by a slight margin, causing an uneven flash. This condition does not affect the work if a proper allowance has been made in estimating the slug size.

A high-speed saw used for cutting slugs is shown in Fig. 5. The two $2\frac{1}{2}$-in. bars shown in the vise, fed simultaneously, are cut into slugs, $1\frac{7}{8}$ in. in length. These slugs are used for making the parts shown in Fig. 6. In Fig. 7 the constructional details of the die are given. At *A* is the slug, and at *B* the completed ring after trimming. The deepest impression is made in the upper die so that the metal will "shoot up" when the dies are closed. The die blocks are provided with a lock that offsets any wear that might exist in the ways of the hammer, and makes possible a more perfect forging, in that the die blocks cannot shift. The operation is handled in a 2,500-lb. hammer.

Another example of a slug-type forging is the valve body illustrated in Fig. 8. The die used for the forging operation is shown in Fig. 9, in which the left-hand block is the upper die and the right-hand block the lower die. In front of the die can be seen the slug, measuring $2\frac{1}{2}$ in. in diameter and $1\frac{7}{8}$ in. in length, the finished untrimmed forging and two pieces of the completed work. After the slug has been heated to the proper temperature, it is placed on the blocker *A* where it is flattened out and shaped with three bosses, two of which are on the bottom face and one on the upper face. The slug is then placed in the die so that the bosses fit the impression of the die, after which it is struck five blows, completing the forging. This example shows how the metal will flow in a deep impression.

In some cases it is necessary to insert a steel pin or stud in the brass forging, such as illustrated at *A*, Fig. 10. The stud, 5/16 in. in diameter and 1 in. in length, is inserted in the die and over it is placed the slug to be forged. When the slug is struck, the metal flows into the impression of the dies and forms a boss around the projecting end of the stud. Some of the trimmed and untrimmed work, also the studs used, are shown in front of the die. The end of the stud to be forged in place is provided with a neck and a knurled surface so that it will be seized properly by the forged metal. Operations similar to this one can be accomplished successfully, but the insert should be made with anchor slots or grooves to insure a permanent joint.

Retaining Clip for a Scale—Discussion

BY T. COSTELLO
Manchester, England

Referring to the article by John I. Blair under the title given above and published on page 570, Vol. 64, of the *American Machinist*, I have found another use for the clip besides keeping the scale in the pocket. When taking the scale from the pocket, the clip answers as a guide for instantly finding the front edge of the scale.

In my case I have fixed a clip similar to the one described by Mr. Blair to the back leaf of a 3-fold, 12-in. flexible scale. In taking the scale from the pocket, the fingers naturally take hold of both the clip and the scale. Instead of having to examine the scale for the right way to open it, its front leaf is brought level with the eyes at once. Although this is seemingly a simple matter, it saves considerable time.

Sane Specifications and Intelligent Inspection

By Brig. Gen. C. L' H. Ruggles
Assistant Chief of Ordnance, U. S. Army

Accurate nature of ordnance material—Difficulty of visualizing service conditions in peace time—Our problems during the world war—Present program—Cooperation of manufacturers needed

THERE are so many different kinds of ordnance material, that I find it desirable in discussing this subject to limit myself rather largely to a single class, although some of my remarks will also apply equally well to ordnance material in general. I have selected mobile-artillery ammunition as the basis for my discussion on account of its requirements for large mass production and the special considerations required for satisfactory functioning. Mobile-artillery ammunition is the largest item to be manufactured in any emergency, and manufacturers will become more acquainted with this type of material than any other.

During the World War the Ordnance Department was severely criticized because of the requirements of its specifications, and also because it was felt that inspection was not being carried on intelligently. Much of this criticism was justified, but some of it was unjust because it was made without a full realization of the use and requirements for the articles in question. Sane specifications require full knowledge of the essentials necessary to a good usable product. Refinements are frequently added to cover doubtful points on which there is no information, and are then factors of safety, frequently referred to as factors of ignorance. The only satisfactory method of eliminating these refinements is to demonstrate by actual tests that they are not necessary. This is simply saying that the article should be completely developed before an attempt is made to produce it in quantity.

Abstract of a paper to be presented at the New Haven Machine Tool Exhibition, New Haven, Conn., Sept. 7-10, 1926.

An 8-in. howitzer destroyed by a premature burst from defective ammunition. The British had less than one premature burst for two hundred thousand rounds, while one of the allied armies had forty in one day

It is difficult to obtain definite information on the essential requirements of ordnance material due to its infrequent use under service conditions, and because when actually used it is under conditions that make the recording of information difficult if not impractical Tests are, of course, made at a proving ground, but large-scale tests are expensive, so that it is generally necessary to adapt the test programs to the funds available rather than to the technical requirements. There is some use of equipment by troops in training, but such use is necessarily limited and cannot conform to battle conditions.

Our prewar designs were largely developed through small yearly production programs, and no difficulty was encountered in producing to the small tolerances prescribed. Even orders placed with private manufacturers were in such quantities as not to justify mass-production methods. When the large-scale production started, it found the Ordnance Department without the necessary data upon which to base intelligent decisions. The use of artillery and the expenditure of ammunition during the war was on a scale not previously anticipated. This required frequent decisions based entirely on snap judgment, and accounts for many of the peculiar experiences of manufacturers; where one decision might be given at one desk, it might be reversed at the adjoining desk, and perhaps there might be several reversals before the final decision of the Chief of Ordnance was given. Another condition which was responsible for many of the peculiar decisions was the lack of experience of the officers. Due to the lack of a trained

reserve, it was necessary to place in positions of responsibility temporary officers with little conception of the requirements of the material.

It might be assumed that, with American manufacturers having two or three years' experience on manufacturing material for the Allies, and our subsequent adoption of many of those foreign designs, most of the difficulties would have been already solved. The experience of American manufacturers on those foreign orders was undoubtedly of assistance to the Ordnance Department, just as was the adoption of foreign designs and specifications. The confusion arose from the necessity for adopting the designs of so many countries, no two of which agreed on some of the basic principles.

It is the present problem of the Ordnance Department to work out designs and specifications which are proper compromises between the quality and quantity viewpoints, and in this work the assistance of practical manufacturerers is needed. As fast as it can be shown that tolerances on certain of the dimensions can be increased without loss of effectiveness, then such increases will be made. On the other hand, when it is shown that small tolerances are essential, it is believed that manufacturers will proceed to work out methods for obtaining these refinements as they did during the World War, when the necessity could actually be demonstrated.

Errors Are Often Disastrous

In designing ammunition every effort is made to meet the very definite requirements which the artillery service desires. A projectile must first be capable of being loaded into the gun and subsequently passing through the bore. This is the simplest requirement and demands only careful gaging of each projectile. Another requirement of prime importance is safety. Too much insistance cannot be placed on this requirement, and the standard must be higher than on any other product. In ordinary commercial products a reasonable percentage of failures is permitted, since the consequences are ordinarily not disastrous. A premature burst, however, usually results in the complete destruction of an expensive piece of artillery, and frequently in the death of the gun crew. Moreover, the resulting loss of confidence in the ammunition, affects the entire morale of the army.

On account of the disastrous results of a premature burst, a high degree of excellence is essential on all points affecting safety. Premature bursts are possible from several causes. The British had periods where there was less than one for two hundred thousand rounds. There also are records which indicate that during the early months of the war one of the allied countries had as many as forty premature bursts in one day, and at times it was necessary to gage every shell before it was loaded in the gun.

Uniformity of ranging is another essential requirement, and this is perhaps the one that controls the tolerances, and also is the one concerning which the greatest uncertainity exists. A projectile passing through the air at the rate of half mile a second, or eighteen hundred miles an hour, meets a high air resistance, and a number of projectiles thus traveling for a distance of from ten to thirty miles must have uniform resistance in order that they may range alike. This means uniform dimensions, finish and balance. Small changes in contours may have surprisingly large effects on range and accuracy. No doubt many can recall decisions during the late war based upon snap judgment where reasonable concessions were not approved, yet there were cases where apparently harmless concessions were granted, with the result that the range and accuracy were so adversely affected as to make the projectiles useless.

It is of course idle to presume that the tolerances given by the drawings or specifications represent the absolute limit for a good usable product. In fact, in no case is there a definite dividing line between a satisfactory and an uns isfactory product of this kind. There is usually a gradual falling off in the accuracy or other requirements, making it necessary to fix arbitrary limits. For example, the rotating band of a projectile might be moved forward a considerable distance without affecting the accuracy of a group of projectiles, all having the band located in the same place, but if the projectiles having different locations of band were mixed in a manner which would result from permitting a large tolerance in the distance from the base of projectile to the band, the dispersion would be greatly increased.

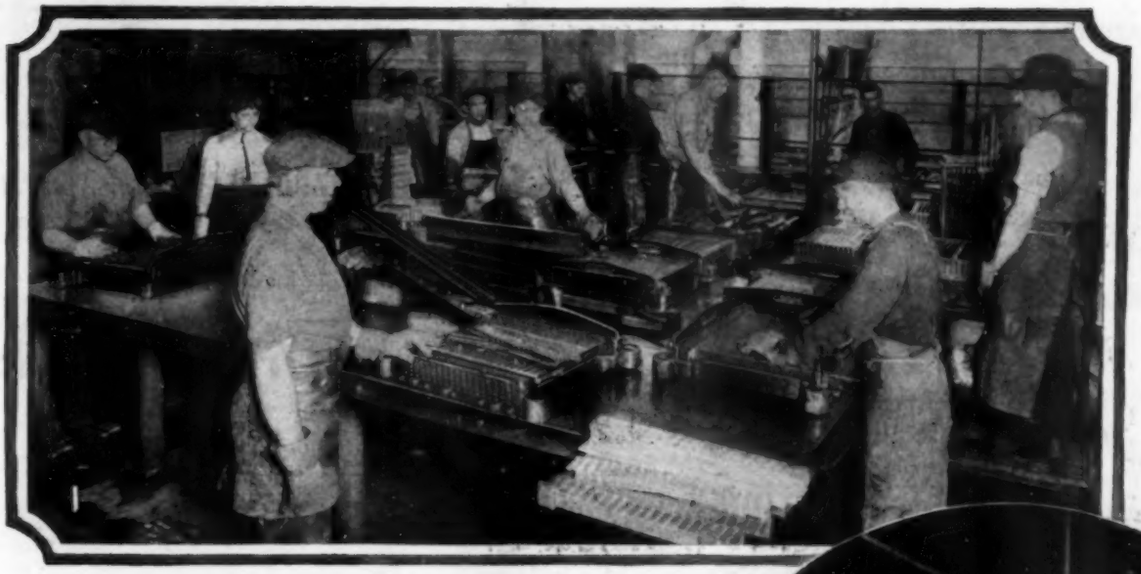
With barrage fire, where the advancing infantry follows closely as practical the advancing line of bursts of the artillery projectiles, inaccuracy of ranging results in projectiles falling among our own troups, causing casualties and lowered morale, or it requires that the infantry follow at a greater distance, making the barrage less effective and resulting in correspondingly greater casualties from enemy fire. Also, if by producing more accurate ammunition we can increase the percentage of projectiles that strike within the effective area, we shall have reduced the requirements not only of ammunition, but of guns to fire the ammunition, personnel to man the guns, and transportation facilities.

You are likely to conclude from my statements that nothing is being done to liberalize tolerances, but the intention has been to cover largely the problem of artillery ammunition, which does not offer a fruitful field for material increases. But a number of classes of ordnance material do offer such prospects. Artillery guns and carriages have certain parts such as the recuperators and sight mechanisms which require care, but some of the other parts are less intricate. In all cases the most liberal tolerances consistent with proper functioning are prescribed.

Present Sane Methods

We have adopted the unilateral system of expressing tolerances, and have simplified our drawings by placing the details on separate sheets of a size convenient for shop use. Our specifications are now being placed in a standard form and are being coördinated with commercial specifications. In making these changes we have profited by the lessons learned during the World War and have made full use of the records on manufacture that accumulated during that period.

It will not be practical nor advisable to liberalize the tolerances on all dimensions, but we expect that when a small tolerance is prescribed it will be based as far as practical on actual necessity for the proper functioning of the material and not on the mere caution of the designer. We are submitting our designs to our arsenals for scrutiny as to ease of production. We have also solicited such criticism from manufacturers, but have as yet not worked out a satisfactory methods of obtaining the necessary detail study. We hope that this may be worked out later through our district officers.



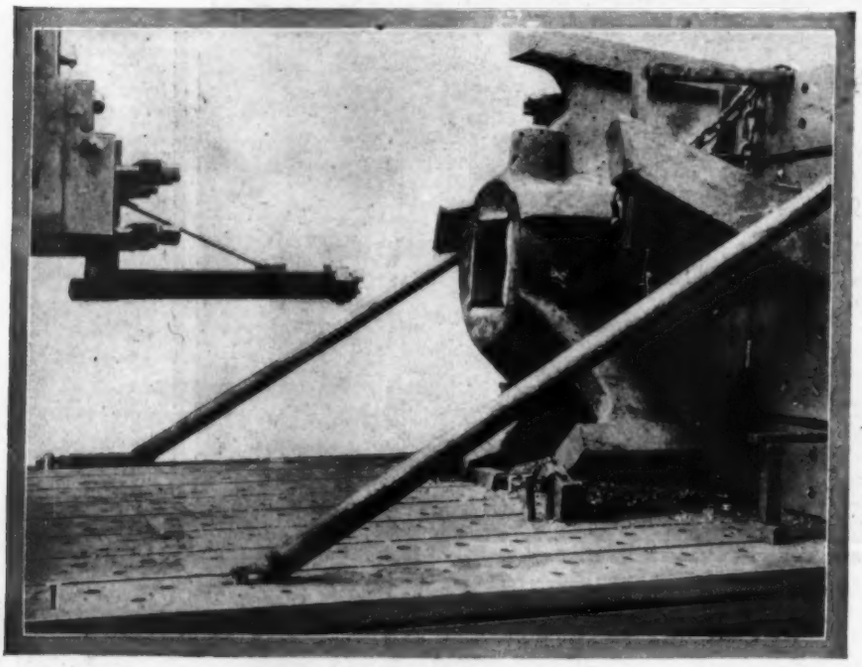
Assembling Automobile Radiators

1—Assembling fins in frames and pressing all tubes in at once

2—Bringing assembled cores and tanks to soldering stands

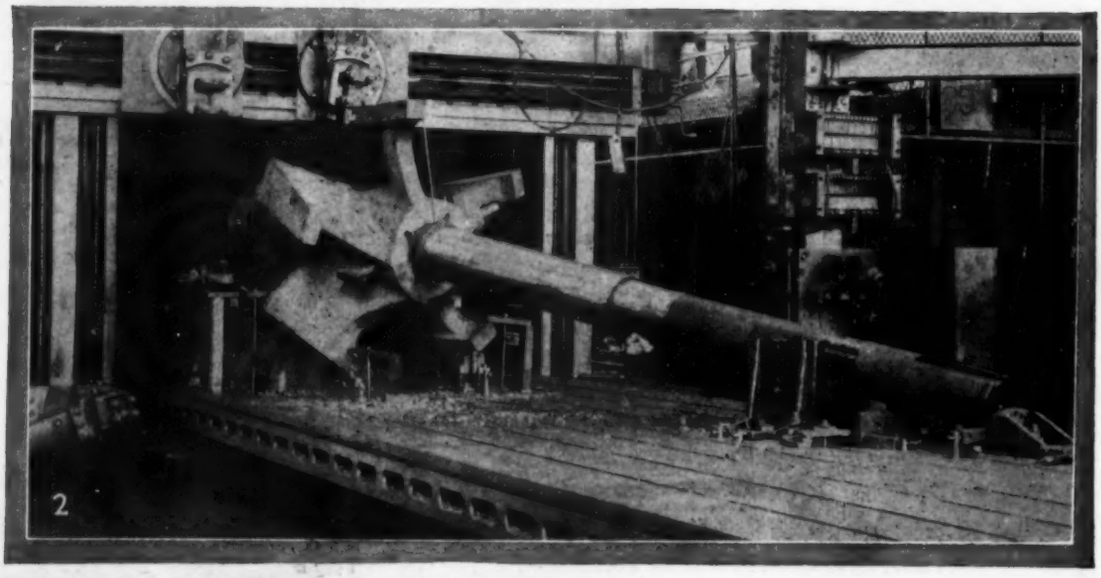
3—After testing, small leaks are soldered at bench alongside belt conveyor

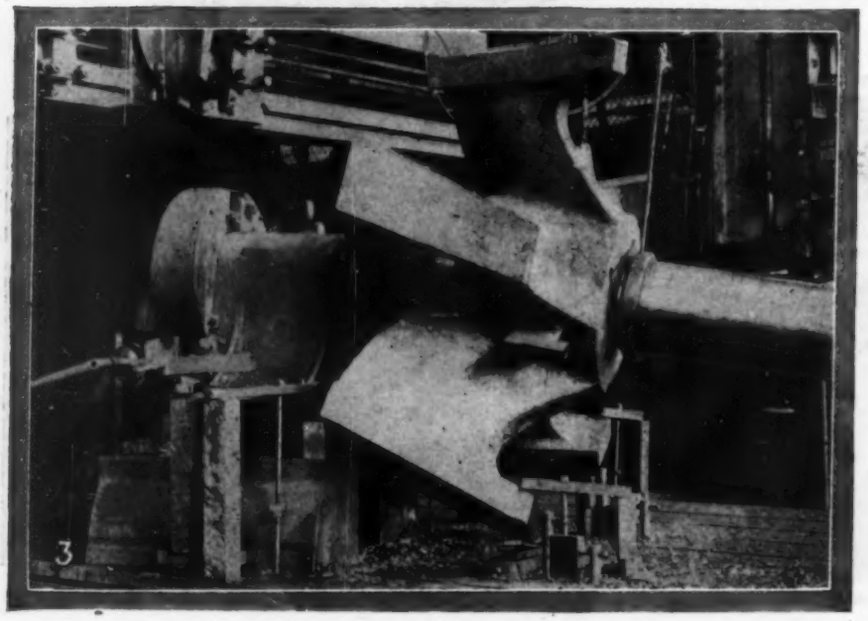
Photographs by courtesy of the Ford Motor Co.



Planing Angles and Tapers in Dredge Work

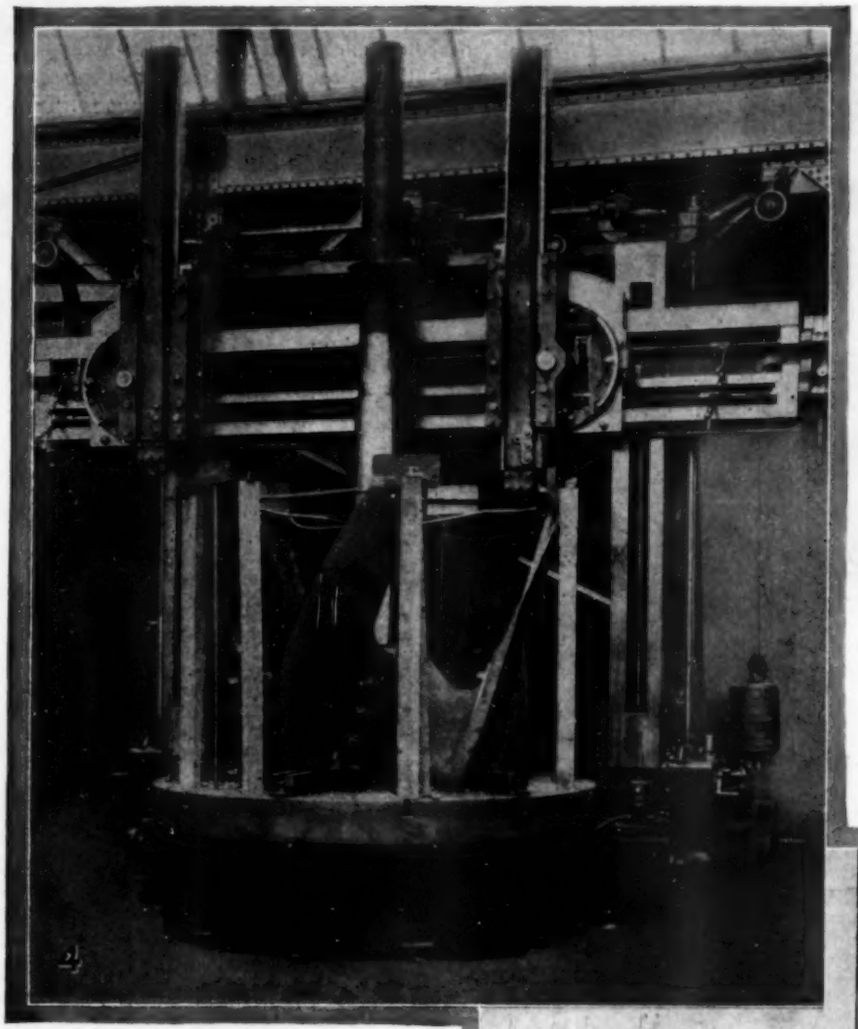
Photographs by courtesy of the Cincinnati Planer Co.





THE planing of a taper and angles on dredge spiders presents a great many problems. To do the work in a shop not well equipped would require considerable rigging for the set-up.

The illustrations show how such work was done in a well-known machine tool shop by comparatively simple methods.

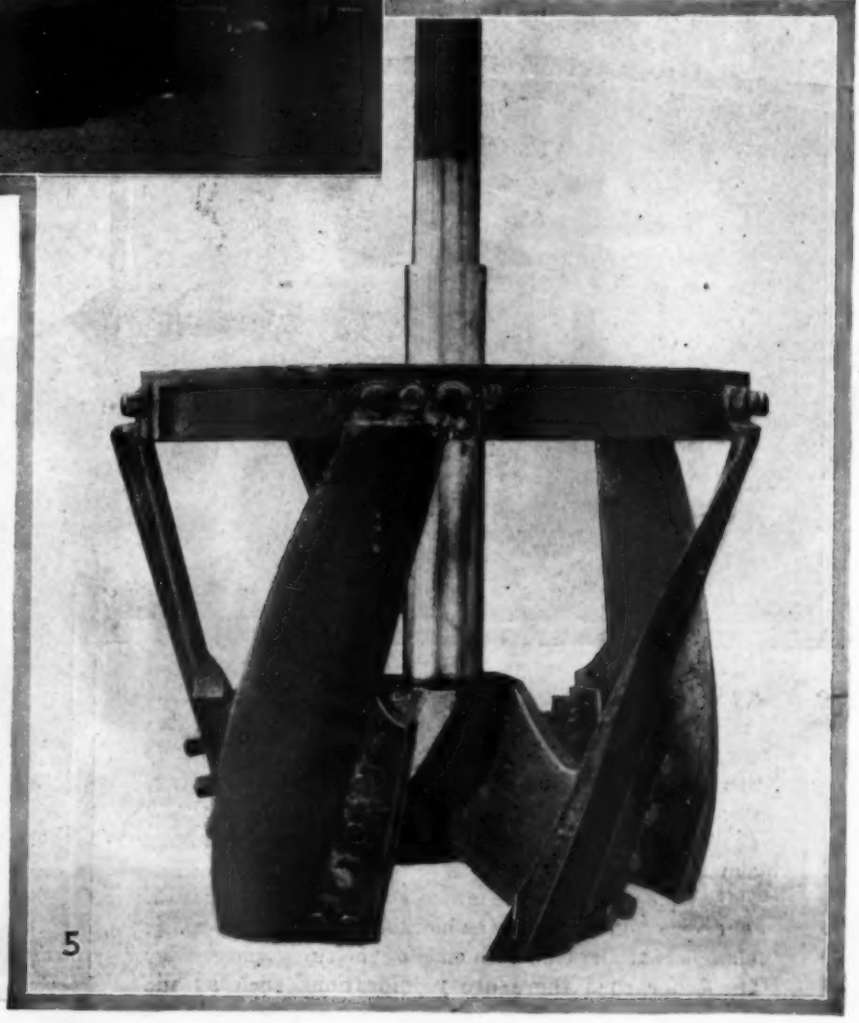


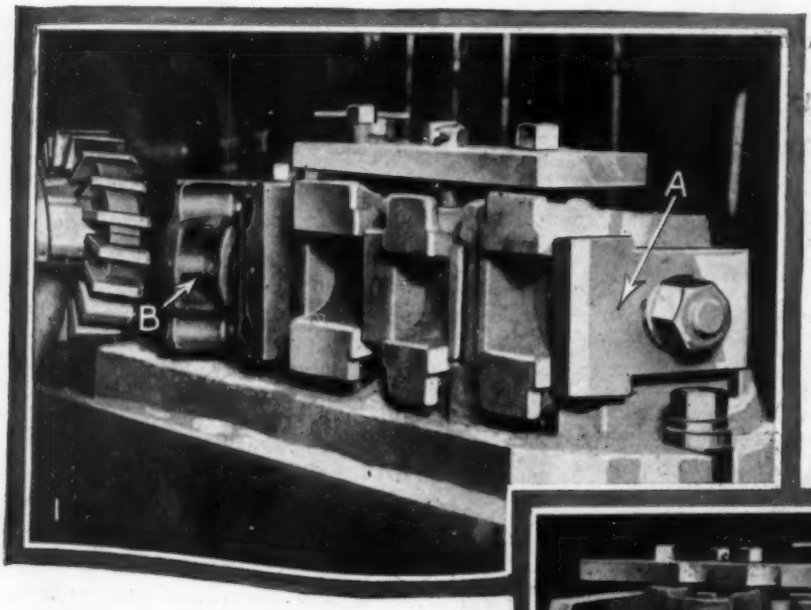
First a hole was bored in the hub to the proper taper and the top edges of the spider were faced on a boring mill. The spider was then mounted on a planer, Fig. 1, using an old planer table as a back stop at the right angle. The table is braced as shown. The tool is held in a small clapper box at the end of the forged bar.

The spider, keyed on its shaft and mounted on a 120-in. planer, is shown in Fig. 2. The outer end of the shaft is held on a block and angle plates are placed at the end and on each side. An index head, Fig. 3, gives the five divisions necessary. The top angle is 10 deg. and the side angle is 19 degrees.

Wings are planed on another planer, assembled on the spider and bolted in place, Fig. 4, where they are bored out to fit the ring. Only ⅛-in. is allowed for finish on the wings so that care is required in setting and machining.

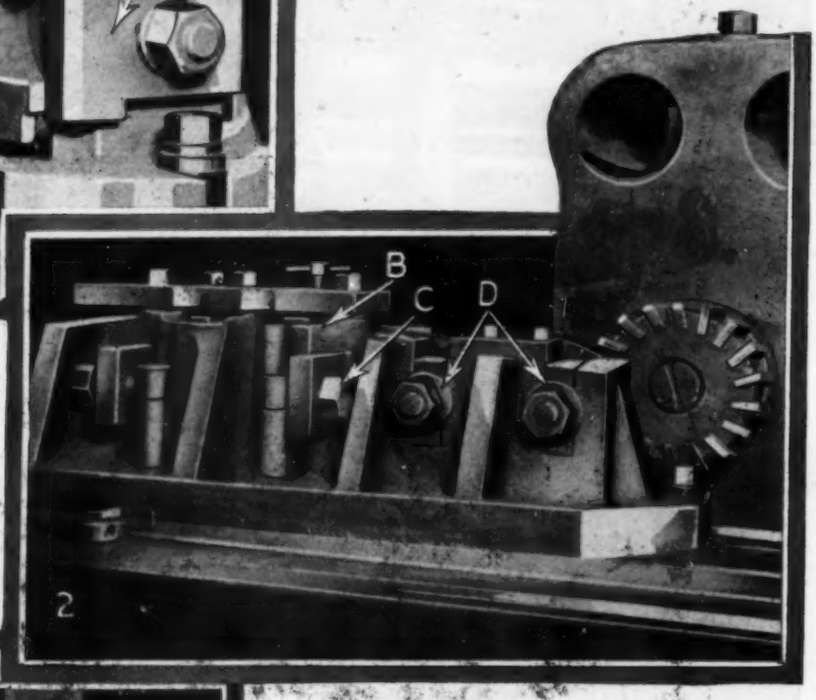
The completed runner for a 24-in. dredge is shown in Fig. 5. Rings are not turned completely but machined only in spots to fit wings. On this ring are shoulders against which the wings abut to prevent their turning.

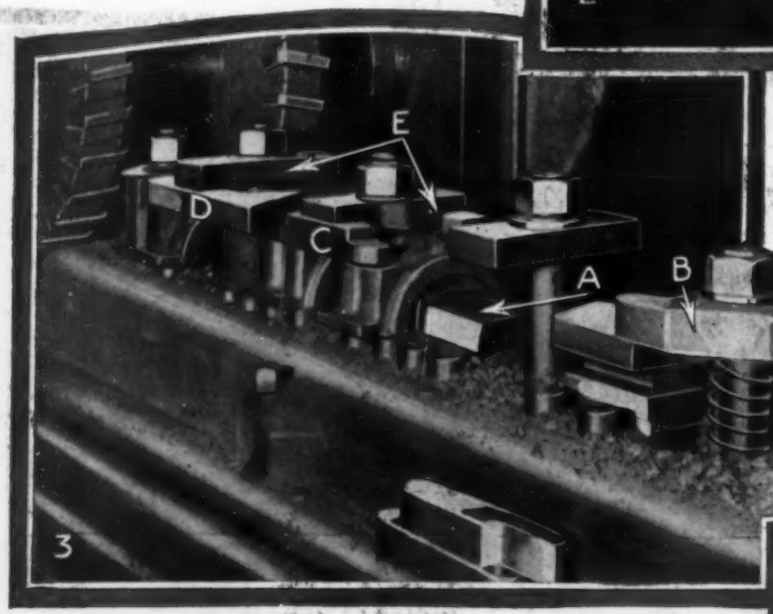


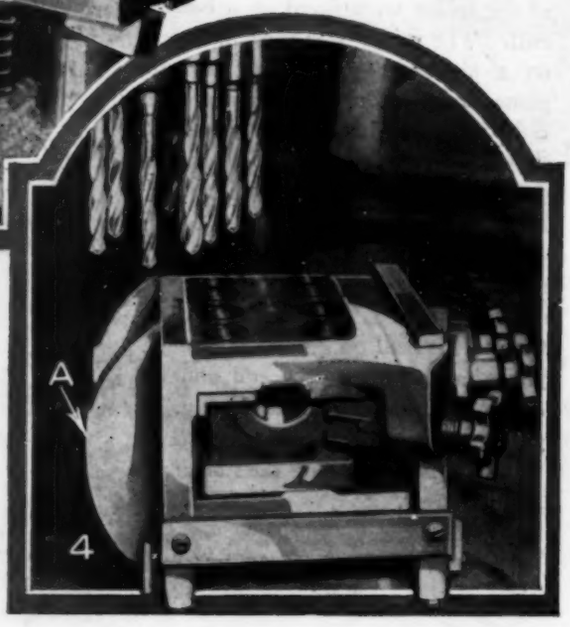


Machining Bearing Caps

Photographs by courtesy of the Cleveland Automobile Co.







THE caps are held between serrated surfaces that grip the work. The end clamp *A*, Fig. 1, operates directly on the side of the first cap. The other two caps are held by jaws that are hinged in the fixture casting, as at *B*, Fig. 2, and are operated sidewise by the screw *C*. The end bearing, at *B*, Fig. 1, is held by pull-back clamps, as in Fig. 2 at *D*.

The caps are straddle milled at the ends as in Fig. 3. They are centered over the blocks *A*. The double-prong clamp, as at *B*, grips both ends of the cap at once. For the other caps there are modifications such as the pieces *C* and *D* that clamp two caps when pressure is exerted by the cross straps *E*. Equalized-pressure straps enable the caps to be easily and quickly clamped. Two sets can be milled at once.

The holes in a complete set of caps are drilled in the fixture, Fig. 4, at one setting. The caps are clamped by their machined surfaces and are held firmly by the clamping screws shown. The fixture is loaded the other side up, but is easily rolled over by means of the rockers *A* at the end.

Automotive Production

How Production Methods Vary in Shops Building "Light Sixes"

By Fred H. Colvin
Editor, *American Machinist*

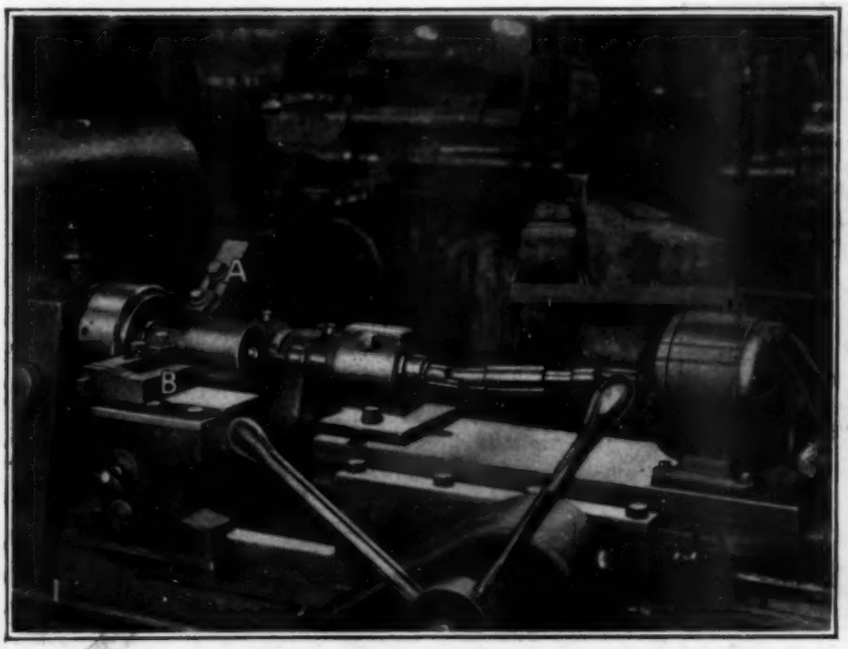
Tools and Fixtures for Making Pistons for the Oakland "Light Six"—Boring and Reaming Pin Holes—Grinding the Bodies and Heads

WHILE piston manufacture has been standardized to a great extent, there are still enough variations to make it interesting. The Oakland method involves a special centering head, mounted on the turret slide of a Bardons & Oliver lathe as in Fig. 1. The piston is held on an expanding chuck that centers it from the core while the back tool at *A* faces the end and the tool in the slide *B* bores the open end of the skirt. The boss on the end is centered by a drill that is driven by a small motor through universal joints. The lathe itself is also motor driven, the motor being on a bracket over the headstock.

The piston is rough turned and grooved in the usual manner and then cross bored for the piston-pin hole in the Davis & Thompson continuous machine, Fig. 2. The pistons are located by the open ends and held in position by the clamps *A* as they pass under the chain that encircles about three-quarters of the work-holding drum. Clamp *A* would normally swing down in the position shown and allow removal of the drilled piston and the placing of the next in position. The pistons are drilled from each side, as can be seen.

Finish turning and grooving are done in a specially-tooled lathe after which the piston-pin hole is finish bored and reamed in the turret lathe in Fig. 3. The special chuck centers the piston by the open end and the centered boss on the head. The reamers are guided by bushings at each end, the outer bushing floating on the reamer and entering a fixed bushing in the fixture. The floating bushings are backed by volute springs that compress as the reamers are fed into the work. The method has proved very satisfactory, giving smooth, straight holes, and securing proper alignment of the

The seventh article. The eighth will appear in an early issue.



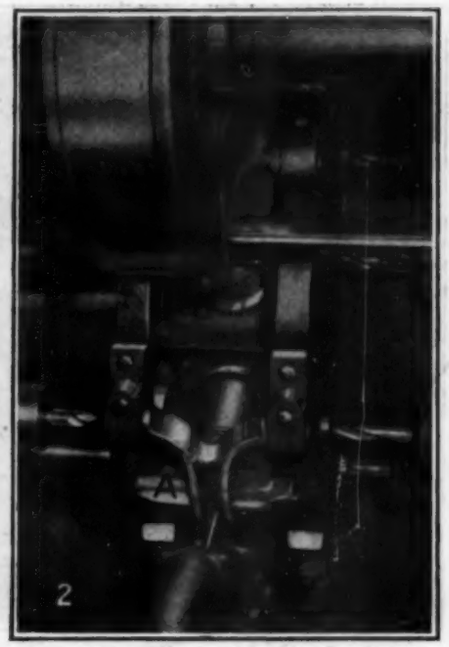
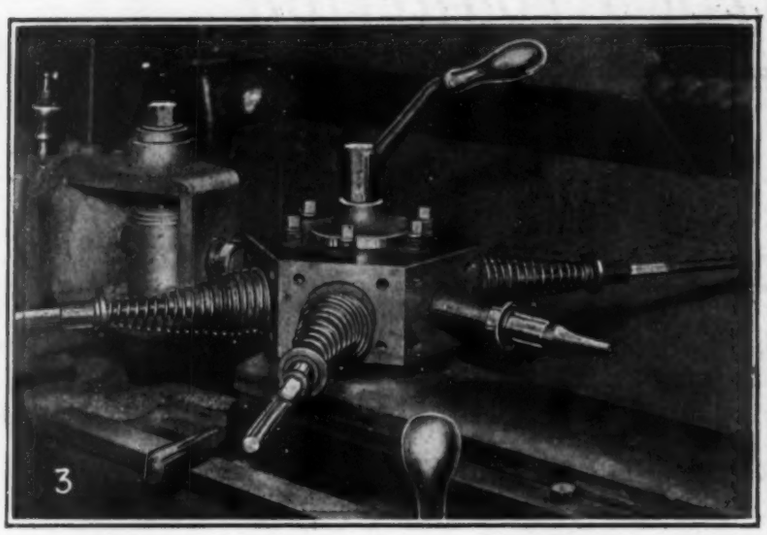


Fig. 1—Boring the skirt and drilling the center. Fig. 2—Cross drilling in a rotary machine

Automotive Production



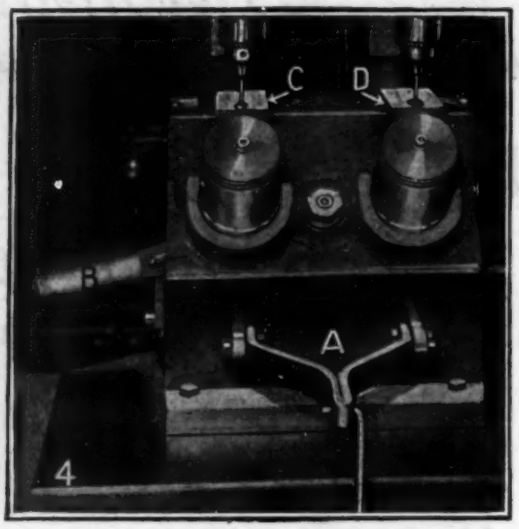


Fig. 3—Finish reaming and the tools used. Fig. 4—Fixture for drilling oil holes

holes in both sides of the pistons.

Oil-drainage holes are drilled from the lower ring groove to the inside of the piston on the double indexing fixture in Fig. 4. The pistons are drawn down on locating bases by loose pins through the pin holes, and links that connect with the double lever *A*. Both pistons are indexed, after drilling, by the lever *B*, operating a ratchet. The drills are guided by bushings in the brackets *C* and *D*.

An Arter piston grinder semi-finishes the pistons on the outside. The pistons are loaded into the magazine *A*, Fig. 5, and fed to the grinding centers in front of the wheel. The piston being ground revolves in the magazine between centers, the opening in the magazine giving ample room for the wheel to do its work. The grinding wheel is inclosed in the substantial housing *B*.

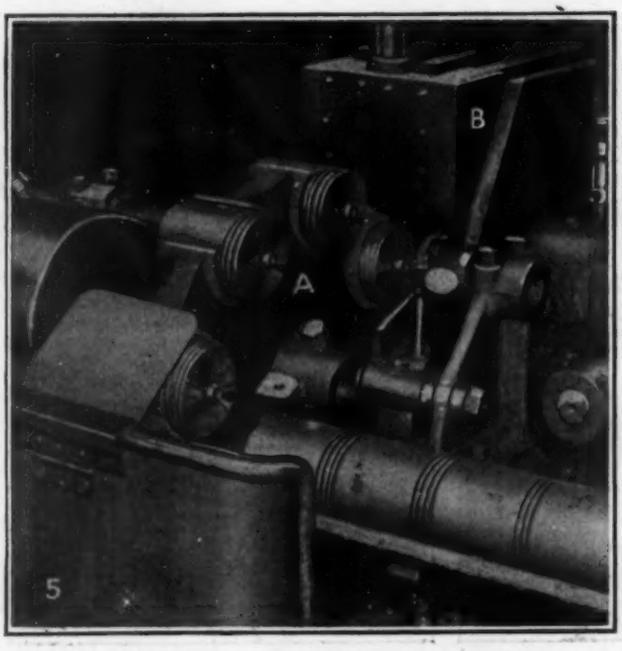


Fig. 5—Grinder with magazine feed

After this operation, the pistons go to a Blanchard grinder and are nested on the table for grinding the heads. The operation is very rapid, the heads being ground smooth after the boss has been removed.

After finish grinding, the pistons are selected for cylinders by the use of a steel ribbon as a feeler. This ribbon is 0.0025 in. thick and gives the proper clearance for expansion and lubrication.

Abstracts

from other publications

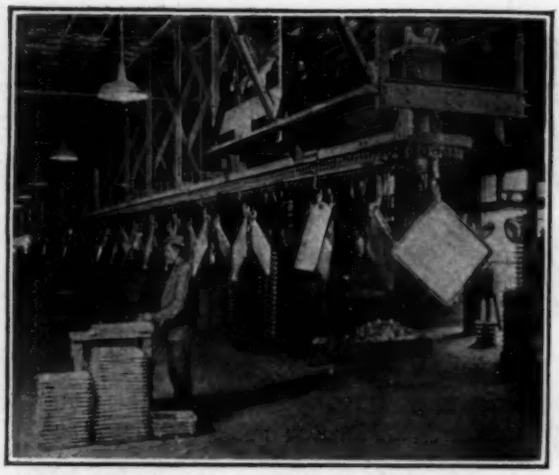
Reducing Inventory

Current inventories of cars and parts of the Packard Motor Car Co., have been reduced from $12,000,000 to $3,000,000 in the last six years, although production of cars has been trebled in the same period. This saving was made possible by a production control system that eliminated inflated inventories at the source.

In building up the system, an analysis was made of the 1,600 parts involved. Complete working drawings were prepared showing all the operations from the rough stock to the finished part, and exact and definite standards were set to govern the purchase of all material entering into the manufacture of these parts.

The purchasing department simply gives orders at specified periods in advance. Orders are grouped according to time periods; thus all orders for products required thirty days before shipment of cars are grouped together.

Certain parts that can be economically manufactured in larger quantities than may be warranted on the basis of sales are manufactured in stock lots determined by a special formula, and are released from stock as needed. —Alvan Macauley in *Manufacturing Industries*, Aug. 1926, p. 89.



Unique Tooling Helps Build Maytag Washers

By Frank W. Curtis
Western Editor, *American Machinist*

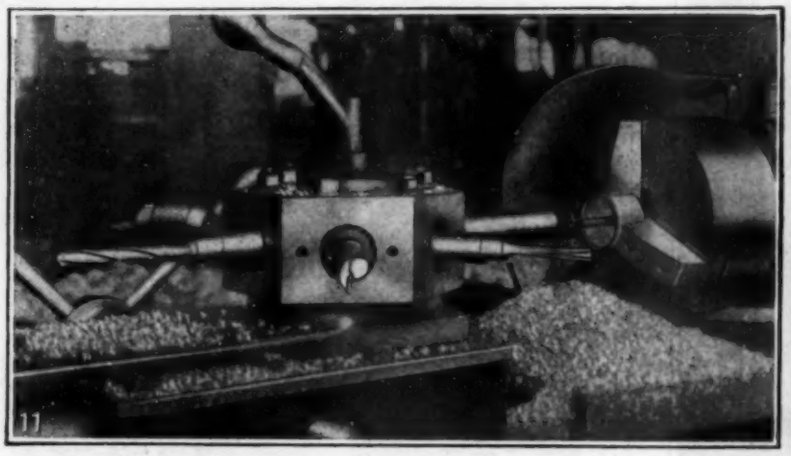
Self-contained spherical-turning attachment—Pneumatic tapping operations — Examples of drum, reciprocating and index milling—Fixture with double-locking clamp

WASHING machines made by the Maytag Co., are provided with either an electrically-operated drive or a single-cylinder gasoline motor of the two-cycle type. In each case a belt is used to transmit the power to the drive shaft of the washer. The aluminum belt-tightener pulley used in the drive is bored to 2 in. in diameter, faced on the open end, drilled and reamed to $\frac{3}{8}$ in., and spotfaced on the inside boss, in the No. 2 Warner & Swasey hand-screw machine as illustrated in Fig. 11. The work is held in a three-jaw air-operated chuck for the operation. Upon completion of the machining, and before the work is removed from the chuck, a $\frac{3}{8}$-in. pin is inserted in a holder in one of the turret faces and forced into the work by hand pressure. A piece is completed in 30 sec., floor-to-floor time.

For the second operation, the work is located by the pin and the inside bore on an expanding plug in the Acme turret lathe shown in Fig. 12, where it is crowned and chamfered on the corners. Approximately $\frac{1}{16}$ in. of metal is removed from the outside diameter, and the operation is completed in 25 sec., floor-to-floor time. In Fig. 13 are shown the details of the tooling used. The plate *A* is provided with the bar *B*, which is beveled at its projecting end to correspond with a beveled plate on the chamfering-tool slide *C*. When the turret is moved inward, the bar causes the slide to feed towards the work an amount sufficient to chamfer the corners with the two tools *D*. A spring mounted on the rear end of the slide withdraws the tools when the bar is disengaged. The arm *E*, also fastened to the plate *A*, is used to operate the crowning-tool holder *G* which is pivoted on the pin *H*. In operation the cutting tool *K* is swung around to the work, after which the turret feed is applied. The front end of the holder is guided by the tongued plate *L*. When the turret is withdrawn, the cutting tool takes the position shown at *M* which permits removal of the work.

Bottom tub-plates have three $\frac{1}{4}$-in., 18-thread holes, $\frac{3}{8}$ in. deep, machined in them in the Gaterman pneumatic, oscillating tapping machine illustrated in Fig. 14. The work is placed on a hand-operated revolving disk which has provisions for four work pieces. An arm

The second part of the article.



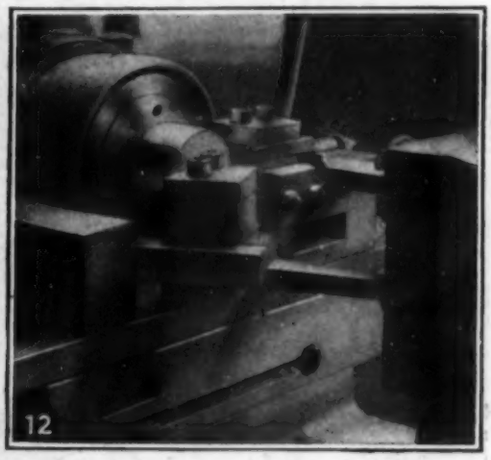


Fig. 11—First operation on idler pulleys. Fig. 12—Turning spherical face of pulleys

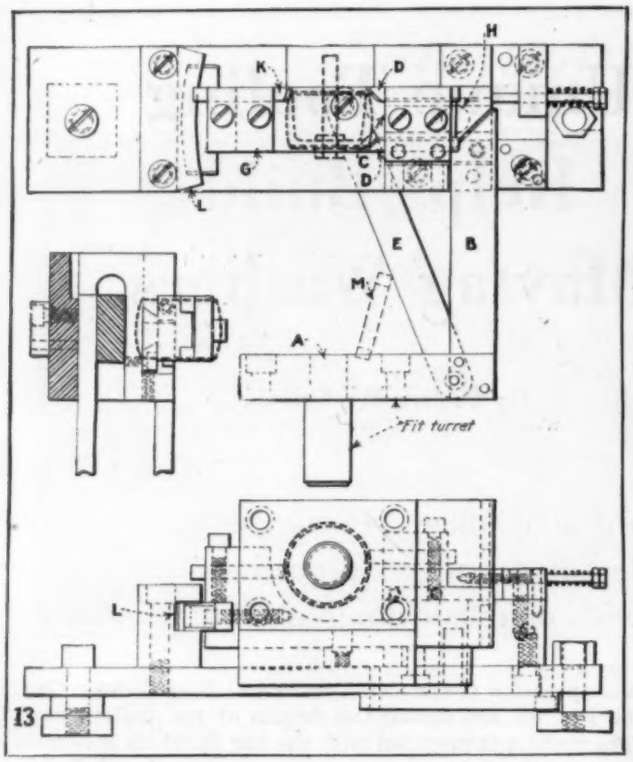


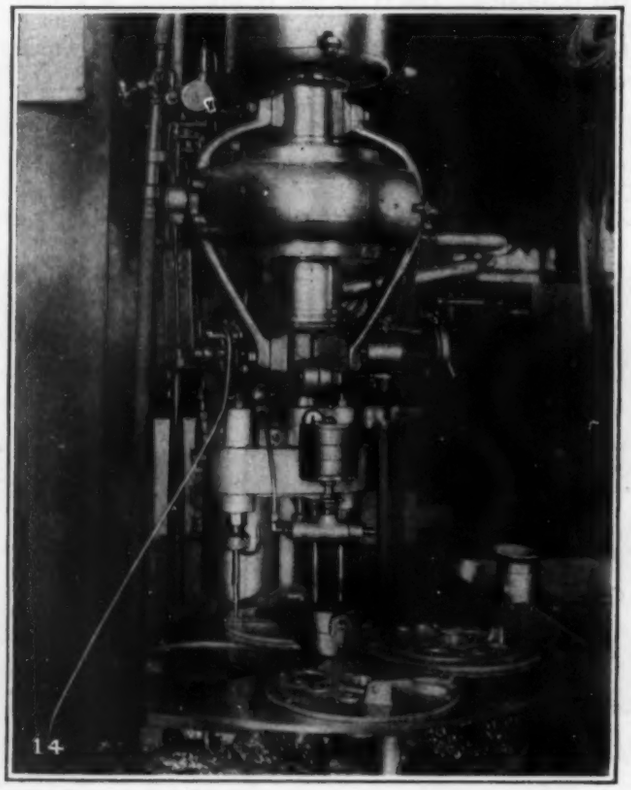
Fig. 13—Details of spherical turning attachment

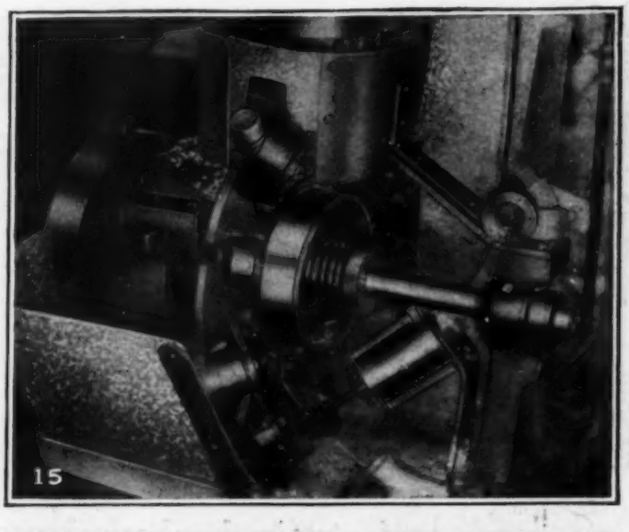
Fig. 14—Pneumatic tapping operation

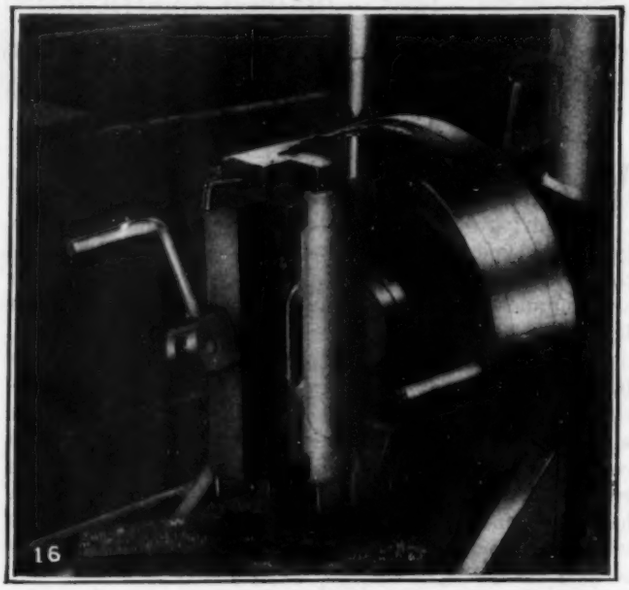
Fig. 15—Semi-automatic tapping operation

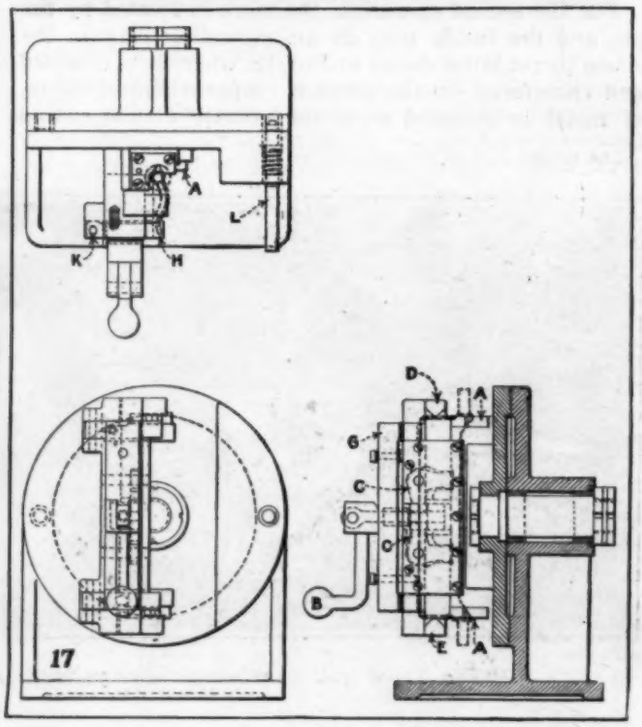
Fig. 16—Indexing jig for wringer release

Fig. 17—Details of indexing jig









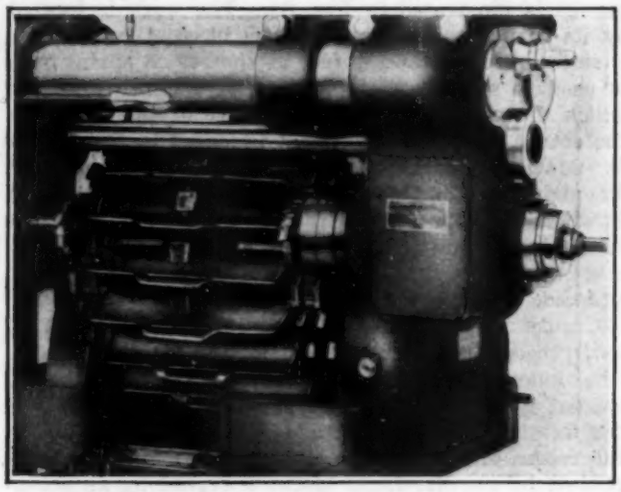


Fig. 18—Drum-type fixture for wringer release

extending from the center of the disk to its rear edge prevents the work from rising when the taps are withdrawn. The machine is foot-controlled and requires an operating air-pressure of 15 lb. The time per piece is 5 seconds.

A similar machine equipped with a vertical indexing fixture is used for cutting a $\frac{3}{4}$-in.-11 hose thread, $\frac{1}{2}$ in. deep, on aluminum drain-nozzles as shown in Fig. 15. The operation is semi-automatic in that the loading of the work is the only hand work required. A separate motor is used to drive the indexing fixture in connection with the tapping head which is equipped with a self-opening diehead. The air cylinder shown in the lower right-hand portion of the machine is used to eject the work after it has passed the diehead. A piece is completed in 4 sec. Threads are inspected by the ring gage shown standing next to a finished nozzle at the right.

A Barnes drilling machine equipped with an indexing fixture, as illustrated in Fig. 16, is used to hollow-mill wringer-release castings. The cut is 0.62 to 0.64 in. in diameter, $1\frac{7}{8}$ in. in depth, and is completed in 20 sec., floor-to-floor time. Details of the fixture used are shown in Fig. 17. The work rests on two V-blocks *A*, and is held in place by a double-acting clamp that centralizes its location vertically as well as clamping against the V-block. When the handle *B* is operated, the toggles *C* are actuated to engage equally the slides *D* and *E* that grip the edges of the work. Movement of the handle in an inward direction causes its cam-cut face to bear against the plate *G*, which in turn bears against the clamps *H*. The clamps, pivoted on the pins *K*, have contacting surfaces that are beveled and serrated to hold the work firmly in place. Indexing is provided by operation of the pin *L* which fits in hardened bushings located in the fixture body, thus maintaining accuracy.

Wringer-release castings have a slot machined in each hollow-milled portion, as illustrated in Fig. 18. The drum fixture, holding eighteen pieces, is continuous in operation and requires 6 min. to complete a revolution. A $\frac{3}{4}$-in. side-milling cutter, operated at 145 r.p.m., produces a slot $\frac{7}{8}$ in. in depth. The work pieces, placed in V-blocks located on each side of the drum, are held in place by the spring plungers as shown. When the work nears the cutting position, an automatically-operated cam-hook clamp grips both ends of the work firmly. This cam is released likewise after the completion of the cut.

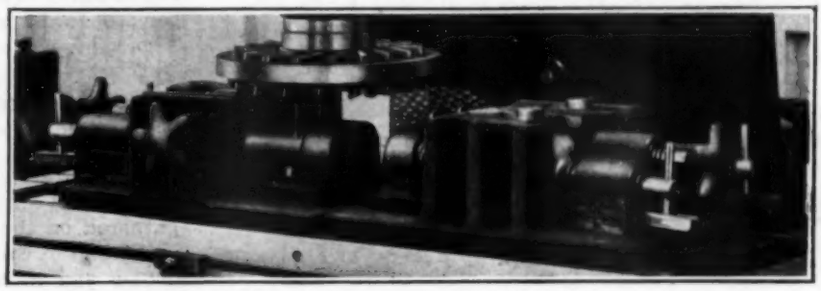


Fig. 20—Milling wringer-release housings

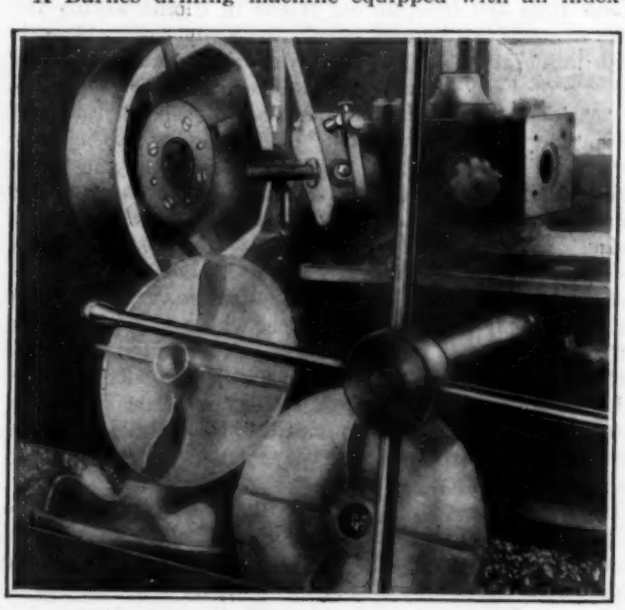


Fig. 19—Air-operated chuck for gyrotators

The inside revolving member of the washing machine, called a "gyrotator," presents a difficult chucking problem in that its surface is irregular For the boring and facing of the center hole an air-operated chuck is used to grip the work by its four ribs. The work, shown in the pan of the No. 6 Warner & Swasey machine, Fig. 19, fits in the chuck with its ribbed portion on the inside. Four V-blocks, equally spaced, are used to locate the work. Two of the V-blocks are stationary and the remaininig two are connected with the air-operated plunger. The hole is bored and reamed to 2.121-2.122 in., and a bevel is cut on the inside face of the hole to facilitate assembly of a brass pipe that is pressed in at assembly. A unit is completed in 35 sec., floor-to-floor time.

Wringer-release housings have a pad and a boss faced in one cut in a horizontal milling machine equipped with a vertical-spindle attachment as shown in Fig. 20. Two fixtures, each of which is arranged to hold two pieces, are mounted on the table. While one set is in operation, the opposite side is being loaded. The work is located centrally from its inside surface on a hardened pin, and on its housing face against a fixed side. An adjustable-wedge block operated by the star wheel

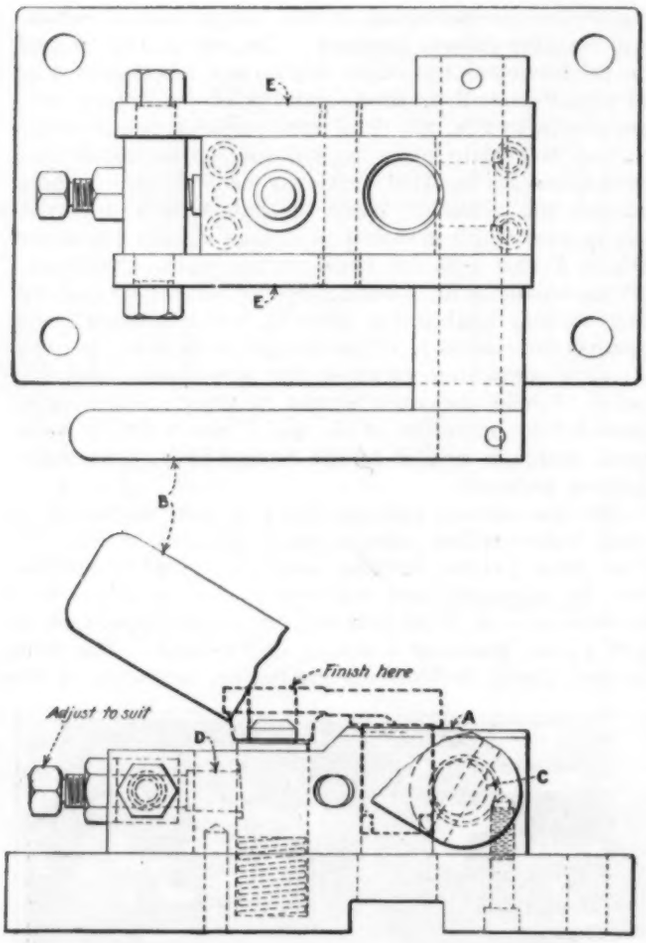


Fig. 21—Single-lever locking fixture for cranks

is used to clamp the work firmly. An inserted-blade stepped-tooth cutter, provided with 7- and 10-in. cutting faces, is used to machine the two different heights of each piece. The material is cast iron, the depth of cut is approximately $\frac{1}{16}$ in., the width of the pad is 3 in., the cutter is operated at 26 r.p.m. at a feed of 5 in. per min., and the production obtained is 220 pieces per hour.

The fixture used for facing the top boss of cast-iron

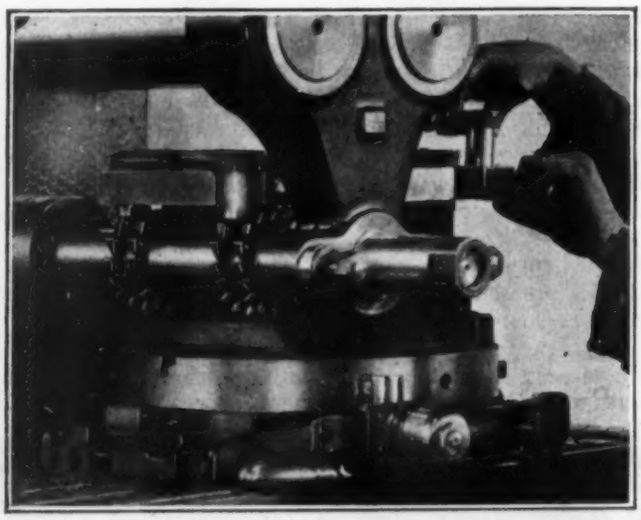


Fig. 22—Indexing fixture for cranks

cranks is illustrated in Fig. 21. The work is located by its turned surface in the steel block *A* so that its shoulder rests on the top face as shown. A spring jack is used to support the opposite end of the work over which the cut is made. The feature of the fixture is the double-locking arrangement produced by the handle *B*. Movement of the handle binds the work with the eccentric pin *C* and also binds the jack with the lock-pin *D* which is attached to the two side straps *E*. The eccentric pin and the straps have a floating action so that they can adjust themselves to suit the work at hand.

Cranks are straddle-milled to $\frac{3}{4}$ in. in width and $\frac{3}{8}$ in. in depth, on the $1\frac{1}{8}$-in. turned end, as shown in Fig. 22. The indexing fixture holds eight pieces which are located against the hardened plate shown on the top of the fixture, and by the outside diameter which fits in the recess of the plate as shown. Clamping is accomplished by angular-faced blocks operated by an eccentric-clamping lever. Each block holds two work pieces. The milling of four pieces at either end is accomplished from the under side of the top plate by two sets of cutters, each of which mill two pieces at one pass. Upon completing one side, the fixture is indexed 180 deg. The production is 250 pieces per hr. Plain milling cutters, 4x$\frac{1}{4}$-in., operated at 80 r.p.m. with a 7-in. per min feed are used.

Overlooking the Foreign Buyer

By F. P. Terry
Belfast, Ireland

A few evenings ago a party of machine shop men gathered on the banks of the Clyde, and naturally the conversation consisted of a good deal of "shop."

"Do you know who sells the X drilling machine?" asked one of the party, naming a well-known American make. The inquirer, a young machine shop foreman, had used this machine in a previous shop, but having resigned, the relations at the moment were not exactly of a cordial nature, consequently he could not well apply to them for the necessary information.

This inquiry also recalled a similar one I received some time ago from an old friend in Brazil, asking for the name of the London agents for a well-known American lathe, and it arises from the fact that some advertisers overlook where the *American Machinist* circulates, and fail to give particulars of their British and other foreign agents. This old friend, when he buys machine tools, must requisition on London, and when American tools are wanted he must name London agents, or he is told to "come again" with something else.

In Great Britain we have many firms importing machine tools, but it is against human nature to expect them to busy themselves advising where to get machines that they do not handle, and quite naturally they take the opportunity to press home a substitute if possible. Looking through my copy of the *American Machinist* for this week, I find many machine tools and small tools advertised which are well-known and extensively used in Britain, but the advertisements carry no information as to representatives here, or elsewhere, out of the United States, and this fact must affect business. No doubt some firms think it a simple matter to write for particulars, but this means considerable delay, and some of us prefer to take a chance with the importers.

A Plea for Loose Belts

By C. C. Hermann

BELTS are designed to operate loosely, and that they are not so operated is at times due to a desire to avoid slippage, but more generally due to a misunderstanding of what constitutes good belt management.

The first requisite for successful operation is that the pulling strand of the belt be the bottom strand. The reason for this is obvious to anyone with the least degree of mechanical knowledge. Under this condition the top strand contains all the slack, and the belt wraps further around the pulley and thereby increases its contact surface. A tight belt, on the other hand, has at best 180 deg. of contact with the driven pulley, where the driving and driven pulleys are of the same diameter. In fact the contact with the driver is even less than this due to centrifugal force that causes the belt to lift slightly as it comes off the pulley. One might be induced to believe that centrifugal force will lift the loose belt more than a tight one, but this is not the case unless the belt is exceedingly stiff. If the belt is pliable and soft, it will cling to the pulley surface, thereby increasing the contact from ten to fifteen per cent on the driver and nearly double this amount on the driven pulley.

The second requisite in order to run a belt slack is that it be soft and pliable. In order to attain this condition, the natural oil of the belt must be retained as far as practical and what oil is lost must be replenished. The selection and the application of a belt dressing should never be left to an inexperienced person. One of the most important duties of the engineer is to specify the grade of dressing to be purchased and to see that the millwright applies the dressing in the correct manner. That there are two sides to a belt is a fact that is often overlooked when the dressing is applied only to the pulley side, due, perhaps, to the old mistaken idea that the driving qualities exist in the dressing rather than in the belt. As a matter of fact, the pulley side of the belt is always under compression and the tension fibers, which are actually doing the pulling, are found outside the neutral axis of the belt. The fibers in the under side of the belt buckle and compress as they go over the pulley and then stretch out as the belt leaves the pulley. The fibers in the outer side of the belt stretch in the straight run of the belt and then stretch still more at the pulley.

Friction within the belt caused by the continuous working of the fibers against each other as they expand and contract results in the elimination of the natural oil of the belt. As shown above, this action takes place throughout the belt, except on the neutral axis. Dressing should be applied, therefore, to both sides of the belt, particularly in the case of double-ply belts.

A third requisite in order to run a belt slack successfully is that the belt be clean throughout. A belt filled with mineral oil appears pliable, but it possesses poor pulling qualities. Its flabby appearance is due to its saturated condition. The oil rots the fibers of the belt and thereby reduces the strength and life. Moisture is also detrimental to a belt. A well conditioned belt will shed water, but the glue with which the belt has been fabricated is very susceptible to moisture and the belt is liable to separate at the joints and between the plies. Dust collected by the belt results in the absorption of a certain amount of the natural oil of the belt. Some belt dressings are about as valuable as dirt in preserving the belt, especially those containing resin or other sticky substance, and a belt treated with any of these substances cannot be operated in a slack condition successfully.

About the first result obtained from the operation of a slack belt is long belt life. Forty to forty-five per cent of its working period is spent in relaxation. The continuous stretch and contraction of the fibers seems to keep the belt elastic just as in the case of rubber. The tension must, however, be within the elastic limit of the leather at all times or a permanent set occurs.

The second result obtained is less slippage of the belt. It was pointed out above that the belt wraps around the pulleys and increases the contact area when run slack. There is entirely too much pulley surface going to waste in the average belt drive that could be utilized. Of course, the smaller the pulley, the less is the slack that can be permitted. In any case, the top and bottom strands of the belt should not touch. The mere fact that the belt is slack, however, does not guarantee that slippage will be avoided in the drive. The belt must be pliable, soft, and in good condition.

The third immediate result of operating the belt slack is the elimination of excess wear and heating of the bearings. It is the initial tension placed in tight belts that causes so much heating of bearings and consequent delays in production. The old policy of "making the new belt just as tight as possible because it will stretch anyway," is out of date. The abandonment of this policy will result in a smoother running shop, less transmission loss, and lower transmission cost. The operating belt pull should not exceed sixty pounds per inch of width for double-ply belts and thirty pounds per inch of width for single-ply belts. The initial tension should be such as to prevent the top and bottom strands of the belt from slapping together when the belt is running.

The fourth result obtained is greater horsepower transmitted with the same belt width and ply. The transmitting power of a given belt is approximately proportional to the ratio of the degrees of arc to 180 deg., which is the average of most drives.

Welding Is a Necessity in Our Far West

By J. Madden

The "putting-on" tool is popular on the Pacific Coast. In localities where it is difficult to secure steel stock, and where freight costs on small lots are high, welding plays a very important part in industry.

Broken parts are mended, as would be expected, and as they are mended in the East. However, more breaks are necessary in the West to send a piece to the scrap pile.

There is more building-up of worn parts. Many shafts that are at fault only in having their journals worn out are built up and re-turned. Cost of welding must be offset by saving in freight and material, ordinarily. Sometimes, however, time is the only consideration. Before new steel could be secured from the source of supply the welded part can be in operation and making money for its owner.

Quite naturally, very good welders have been developed. They are men who are proud of their work and who do not let precedent interfere with trying new jobs.

THE · FOREMAN'S · ROUND · TABLE

Getting Information from Catalogs

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

"WHAT'S that you've got, Al? Thinking about starting business with a boring mill?" Ed was feeling a little more cheerful than usual.

"Not exactly, Ed. And yet if I were starting business I'd give this boring mill a mighty close look, as a machine to buy."

"But why waste your time on catalogs, Al, when you haven't looked to see which ball team won the game today?"

"I'll read about that later. But I'm interested in seeing what these people have to say about handling short lathe work—or what we usually think of as lathe work. There's a lot of information tucked away in some of these books that we call catalogs."

"Well, I never saw one yet that interested me especially. They're just advertisements that try to get you to egg the old man into buying one of their machines. It's real, practical work that counts, not paper stories that some advertising man dreams about."

"Of course they are ads, Ed, and of course they want to sell the machines. Otherwise they couldn't spend good money on books like this and give them to shop men like me. But if you never take time to read them and study them, you're missing a real bet. I have about a dozen such books that I wouldn't be without. I've learned a lot about how to chuck work, what sort of boring and turning tools to use, and about speeds, feeds, and cooling compounds. Why, Ed, those books have been a liberal education to me.

"Take that book on turret lathes that I got last spring. It gave me a lot of pointers on how to handle a large variety of work with standard tooling equipment. I got a lot of direct help on that last motor body job just from that book alone."

"But you bought that Machine Shop Library, too, didn't you, Al—the one that red-headed chap was selling last fall? Didn't that have all you needed to know?"

"Look here, Ed, no books have ALL we ought to know. That library I bought is good—I've got a lot of real help out of it. But no one book or set of books has it all. So I get these so-called catalogs and booklets from builders of different machines, to add to the rest. They are all worth while—they all help. And if you pass up the chance to get books from builders of machines in your line—you're missing a real bet, as I said before. You better get busy and study how the other fellow does it."

Do you agree with Al that many advertising booklets are valuable? Or was Ed right in thinking they are only good to help sell machines? Al says he has found direct help in such books. Ed doubts it. Which is right?

All foremen are urged to discuss these questions. Acceptable letters will be paid for. The discussion is not limited to foremen, of course

Discussion of Earlier Topics

Keeping Machines on the Job

THE first thing to determine is the shop policy. Should machinery be driven to destruction or nursed along? The cost department should be able to decide. If the life of the machine under consideration will be a certain length if driven to the limit and a more or less certain other length if nursed along, then it is merely a slightly complex bit of arithmetic to compare the two. The one unpredictable item is improved machinery coming on the market. If it is hoped or expected that a new invention will necessitate the scrapping of all the old machinery within a year, the present equipment should be kept running the limit of its strength.

The man to be given responsibility is the man who wants it, provided he is capable. There are some very good production men who have no idea of shop economics, and who would never repair unless absolutely obliged to. There are other equally good mechanics who hate to see machinery abused. Somewhere between these two is a man who applies horse sense to his work, who will beat the department to the knowledge that a certain machine is due for repairs, who will repair it when it can best be spared by the department.

This man should begin by co-operating with the production foreman, or manager, and be certain that his work assures the largest percentage of full working hours of the machine. I suggest that he have the motto "A stitch in time saves nine,' hung up where every foreman will see it.—ENTROPY.

How Should Suggestions Be Handled?

I BELIEVE that it was the superintendent's duty to send for Al, the foreman, and to let him take part in the meeting even though he knew that Al sent Scotty to him with the suggestion.

We can assume that Al was not afraid of the result of an interview between Scotty and the superintendent, and that he did not want to claim any credit for the suggestion. Some men run away with the thought that because they have hit upon an idea they are qualified for the foreman's job.

Superintendents should not necessarily shun or purposely avoid workmen, fearing to recognize them, yet all business of importance should go through the head of the department. It is a human failing perhaps to get a thrill in dealing with the higher up. If Scotty receives no compensation he should feel to some extent paid at seeing it worked out to a successful end.

The superintendent of experience will not favor foremen's meetings at regular set intervals. Nothing ever comes of them unless there is a specific question to decide. The average foreman has not the gift of eloquence of speech and is out of place at such gatherings. Some men do too much talking, some not enough. The latter is the most successful. But the man who knows when it is his turn and when to stop is the real foreman.
—STORRS T. RICHMOND.

Picking Assistants

IT IS always well to plan ahead and to have understudies available. A man is no bigger than the organization he can build up. The proof of his organization is its ability to function efficiently under all circumstances—including his absence. Without understudies for important jobs there can be no real organization.

I believe in promoting from the ranks rather than in bringing foremen from the outside on all occasions. But, it might be argued, suppose you have no one who is really capable of the job available? That would be a condition that should be recognized before the emergency arises and, if necessary, I should bring in a man from outside not as a foreman, but as an understudy to the foreman.

Records intelligently kept and interpreted are of considerable value in picking men, but the danger lies in having minor clerks keep them carelessly with the result that when they are consulted by the "big boss" in an emergency, they don't always check with his knowledge of the men.

As to leaving the "straw boss" in charge, the best system is to have it thoroughly understood at all times that if the foreman is out, any inquiry should be directed to the assistant who can act or if necessary withhold action and take it up with the foreman when the latter returns.—L. F. ADAMS.

Letting A Man Try His Own Way

DISCIPLINE does not necessarily mean machine-like obedience to orders. It is impossible for one man to be right always and if Jimmie uses the right approach in showing that he thinks he knows a better way to do the job, it is better to let him try it. If Ed still thinks his way his best, he can then show Jimmie why he thinks so. If Jimmie still shows a desire to do it his way, Ed can use his authority to compel the use of his method.

The foreman usually takes into consideration factors with which the men are only vaguely familiar and sometimes a little explanation of costs and overhead can show a man that the cost of the special tool or fixture that he thinks would be so little will be more than enough to offset the saving that it would effect.—A. HENDERSON.

THE · NEXT · TOPIC

Teamwork in the Shop

QUESTIONS

What is the principal objective of a manufacturing shop?

What part does teamwork play in reaching the objective?

How should a department foreman treat a request from another foreman for help when something goes wrong?

Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

A Pneumatic "Fishing" Rod

EDWARD STANTON

The fishing rod here described has no piscatorial application; it is employed in the much more prosaic pursuit of "fishing" a strip of sheet metal from behind a blanking press in order to start it in the dies.

The rod is made of ½-in. gas pipe, bent to the shape that can be traced in the illustrations and is provided at the "tip" with a shallow metal cup about 2 in. in diameter. At the butt end is a "thumb" valve to control the flow of air, and a wooden handle of a convenient size and shape by which to manipulate the rod. Beyond the handle a rubber tube connects the contrivance to a pipe leading down from the ceiling, where it joins another pipe running above a row of blanking presses, all similarly equipped.

The pump to which the overhead pipe is connected is a suction pump. Its duty is to keep the air exhausted from the pipes, and the only way that air can get into the pipes is through these improvised fishing rods. A small reservoir in the suction line acts as a sort of buffer to the system so that the pump, which is electrically driven and automatically controlled by the vacuum in the reservoir, will not have to start too suddenly or too often when the valves in the rods are opened.

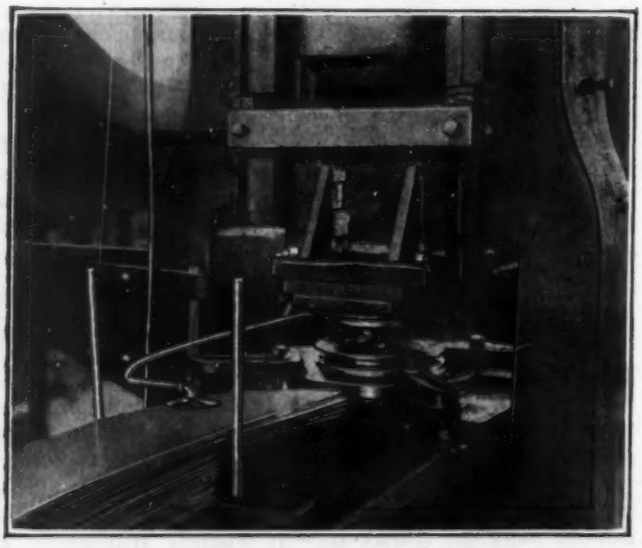


Fig. 1—Using the pneumatic fish-rod

Strip stock is delivered to the long narrow tables behind the presses by truckmen. The stock is oiled by passing it through a roller oiling device just before it is delivered to the tables, so that it is free from dust and grit, and it needs no further attention before going into the dies.

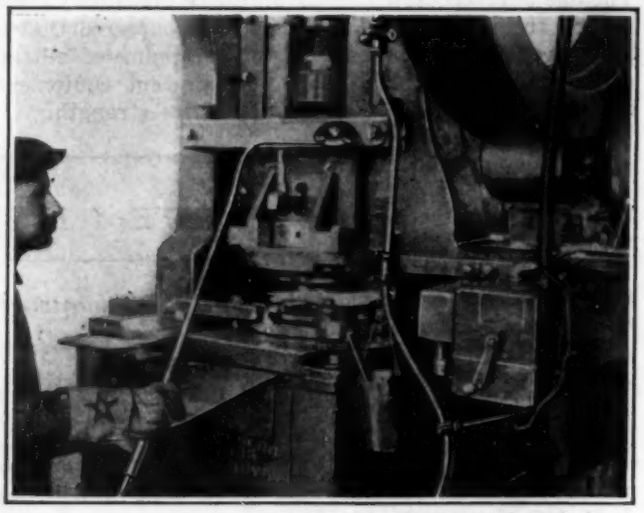


Fig. 2—How the rod looks

Instead of having a helper behind each press with nothing to do but to hand the end of a strip of stock to the press operator occasionally, the press operator reaches under the ram with his fishing rod, places the shallow cup flat on the top strip of stock and depresses the button of the air valve. The suction immediately and quite firmly attaches the cup to the strip and the operator can pull the strip forward into the dies without difficulty.

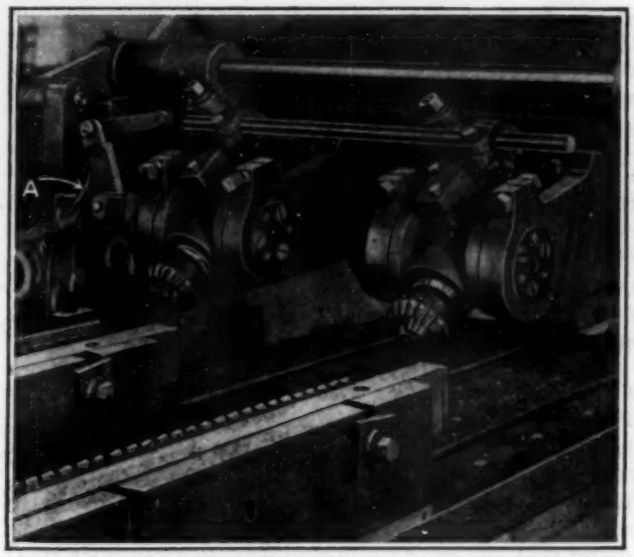
Thus the little contrivance takes the place of one helper to each press, and does not materially interfere with the rate of production.

Broaching Gear Teeth on a Planer

BY CLIFFORD H. FRENCH

Having a large number of bevel gears to cut and not being equipped with machines adapted for the particular gears needed, the tool designers of The Robbins & Myers Co., Springfield, Ohio, made the device shown herewith. They do not claim originality for the idea although the particular adaptation shown was entirely a product of their shop.

Two bevel gear blanks are placed on heads adjusted to the proper angle, the heads being mounted in a substantial support that replaces the cross rail of the planer used for the job. The broaches are in reality a series of independent cutting tools having the proper form for the gear teeth and each is set to take a suitable chip as it passes under the gear blank. They are held, as



Broaching gear teeth at one pass

shown, in substantial tool blocks on the planer table.

Each work-carrying head is provided with a suitable index operated through the bell crank *A*, after each return stroke of the planer table. A complete tooth is secured in each blank at each stroke of the planer. The production has proved very satisfactory.

How Would You Do This Job? —Discussion

BY HENRY DENSMORE

The letter of Henry Seal on page 27, Vol. 65, of the *American Machinist*, appearing under the title given above, reminds me that I have a duty to perform. Though I did not specifically promise to tell how the job was being done, my original letter on page 904, Vol. 63, implied that I would do so.

I am glad to note the interest displayed by the readers in this little problem, and even more pleased to see that at least one of them has solved it correctly. If Mr. Seal and others who have been interested will turn to page 869, Vol. 64, of the *American Machinist*, they will there find the principle outlined in a letter by S. A. Robbins. There is but one trifling error in Mr. Robbins' solution, and that one doubtless an oversight.

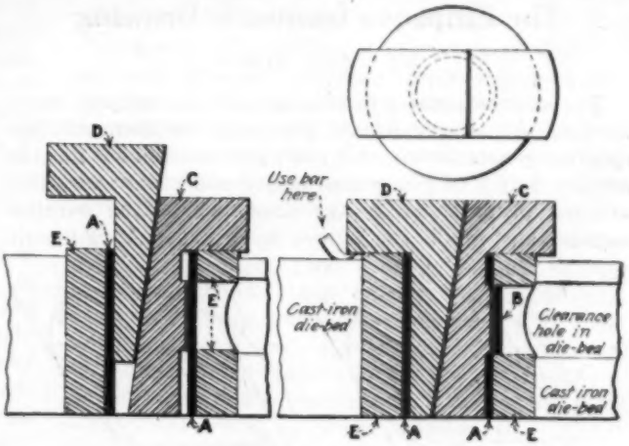
In his cut he shows the back of the wedge-shaped punch as if it were in two planes, and the wedge as if it were shorter than the punch. Obviously, these two pieces should be of the same length, with the inclined backs of each extending over the full length. When the wedge has been driven down by the flat pusher-tool in the ram of the press, the upper ends of the two pieces are even and the bore of the tube is completely filled as with a tightly fitting plug, except that the plug is in two parts, divided diagonally with reference to the axis.

As Mr. Robbins suggests, it is very essential that there shall be a sure means of aligning the "wart" on the side of the wedge-shaped punch with the hole in the steel bushing, for this hole is the die for which the aforesaid wart is the actual punch. This is done by making the head of the punch practically as he shows it, but with the bushing made higher and having a transverse notch in the top to engage the entire offset portion of the punch. There is a similar offset on the wedge so that it may be lifted out of the tube by means of a small pinch bar.

The sketch herewith shows a section of the tools before and after they have been struck by the press. Letter *A* represents the tube to be pierced, and *B* the scrap that is punched out of the side. The accumulated punchings are pushed out through the clearance hole in the diebed.

A tube is placed in the die *E*, resting upon the knockout. The punch *C* is set into the tube with the offset head entering the transverse notch in the bushing. It is essential that the punch go clear down so that it will align with the hole in the side of the bushing, and in order to insure that it does so, it is struck with a lead hammer. The wedge *D* is then set in place as shown in the view at the left, and the press is tripped.

Before Mr. Seal experiments with a die set in a supporting arbor—what we would call a "horn" die in



Punching hole in side of tube

this country—I would suggest that he turn up a ¾ in. plug from any convenient piece of scrap, swing it up in a lathe and bore a transverse hole 27/32 in. in diameter clear through it. Then let him take note of the amount of stock left in the plug at the sides of the hole and speculate upon how much pressure a hardened steel die of this shape and section is going to withstand. My guess is that it would not cut even writing paper, not to mention steel 0.087-in. thick.

Multiple-Operation Press Tools— Discussion

BY JOHN STRAMA

The comment of Robert White, on page 708, Vol. 64 of the *American Machinist*, to the effect that multiple-operation tools may have disadvantages to outweigh their time saving qualities, may or may not be justified; it depends entirely upon the design and quality of the tools. Properly designed, made from the right materials, and operated by skilled workmen, they may perform very satisfactorily indeed.

It is not unusual to obtain from them the same rate of production per day, and at practically the same cost of maintenance, as from a plain blanking die. Further they are more safe against accidents, since the operator's hands are outside of the danger zone. The number of presses and operators required for a given

part may be reduced from two, three, or even four, to one, leaving more presses and operators available for other work.

The equipment of our press department comprises more than seventy presses, ranging in capacity from 5 to 125 tons. There are many multiple and progressive dies, built for presses from 12 tons up to the largest, depending upon the size of the pieces to be produced. In all cases where it is possible to combine operations we follow this process.

Our latest combination is of five dies, formerly used in as many geared presses, now made into one tool to be used in a 90-ton press. The investment involved several thousand dollars and would not have been made if previous results had not warranted it. If Robert White could see this outfit in operation, he might be convinced that the principle of multiple-operation tools is a sound one.

The Ellipse in Isometric Drawing

BY HENRY SIMON

The conventional construction of the ellipse representing the appearance of the circle in isometric perspective is satisfactory for most purposes, but it has the serious defect of possessing major and minor axes that are not proportional to the diagonals of the parallelogram into which the ellipse is drawn. As a result,

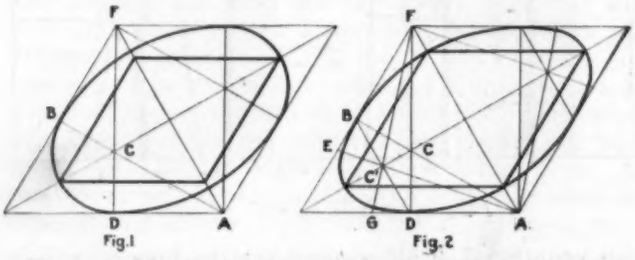


Fig. 1—Conventional method of constructing an approximate ellipse. Fig. 2—Modified method described in the text

it is not possible to describe any polygon within the ellipse without considerable distortion. The parallelogram described in Fig. 1 shows the extent of this error, which will recur every time, for instance, that the end of a shaft must be squared, or finished to hexagon, octagon or similar cross section. This error is even more troublesome in the case of many irregular shapes, which are distorted to such an extent that it often is very difficult to draw them with any degree of accuracy.

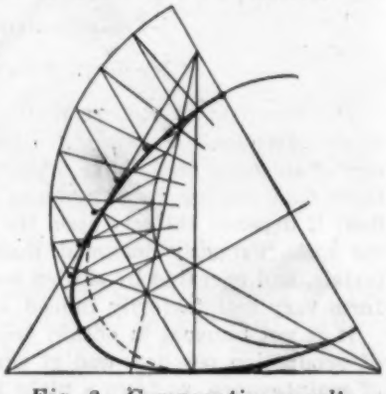


Fig. 3—Comparative results

In Fig. 2 there is shown an approximate ellipse construction that avoids the larger proportion of these troubles without adding any others. The basic parallelogram is drawn entirely with the 30-deg. triangle and is, in fact, not changed in any way. The construction of the approximate ellipse, while slightly different, is hardly more difficult than that of the conventional figure. In Fig. 1, the center *C* of the small arc is found by the intersection of *AB* with the diagonal of the parallelogram. A perpendicular from *F* to *D* also intersects *AB* in the same point. In Fig. 2 to find the center *C'* of the small arc, draw *AB* at 30 deg. to the horizontal, as before, and from *B* draw *BD* at 60 deg. to the horizontal. The point *C'* is the intersection of *BD* with the diagonal of the parallelogram. The centers of the large arcs are *A* and *F* as usual, and *AE* and *FG* are the common radii of respective pairs of small and large arcs.

In describing the ellipse, the larger arcs are drawn first, and then the ends with *C'* as center. As shown in Fig. 2, a parallelogram exactly similar to the basic parallelogram can be described, due to the fact that the axes of the ellipse are proportional to the diagonals. While, of course, nothing but a true ellipse can give entirely logical results all the way through, it will be found that the proposed figure will do away with most of the difficulty, because the basic elements are correctly proportioned.

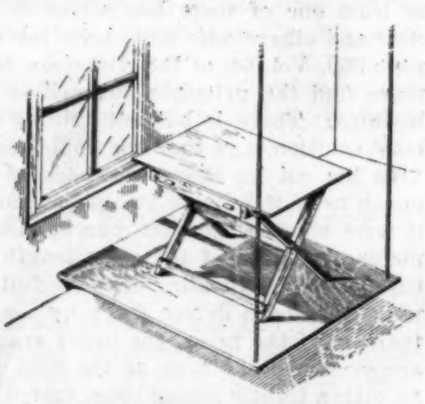
As will be noted, the new figure does not produce any greater sense of variation from the true than the conventional one. In Fig. 3, the new approximate ellipse is shown in solid lines with the conventional figure in dotted lines, and the form of the true ellipse in heavy round dots. It will be seen that the proposed form is, if anything, the closer approach to the true ellipse.

Steadying the Drawing Table

BY HERBERT F. CRAWFORD

Vibration may have its place in the foundry for jarring patterns loose in the sand. But it doesn't help in laying out work on the drawing board at all. So, to eliminate the floor vibration and secure a steady drawing board for the engineer, the Stanley Insulating Co., Great Barrington, Mass., rigged up the suspended platform shown.

The end of the platform is hung to the wall of the building, which is free from the objectionable vibration. The outer end is suspended from the roof trusses by cables as shown. The platform is large enough to hold a good sized drawing table and a stool, and by the way it is suspended it eliminates vibration troubles on even the most intricate layouts. The engineer can stand on the platform if he prefers.



Suspending a drawing table

There are probably many other places where a somewhat similar arrangement can be used to advantage. One case could easily be the suspending of instruments that might be affected by too much vibration without some such device.

Characteristics of Chromium Plating

Chromium plating has been done on a commercial scale only in the last five years. It is now generally considered as having great possibilities as a metal covering where effective protection against corrosion is desired, or where great hardness and resistance to wear are demanded.

Chromium is a hard tin-white metal, and when polished has a beautiful lustre. It is a rare metal and belongs to the same group of metallic elements as molybdenum, tungsten and uranium. Most of the ore at the present time comes from Rhodesia.

Deposited chromium plate is claimed to be harder than hardened steel, and to resist the attacks of atmospheric corrosion better than any metal except gold and platinum. Nitric and sulphuric acids have no appreciable effect on the metal, but it is soluble in hydrochloric acid. Neutral chlorides, such as sea water, however, have no effect on it. Articles plated with chromium can be heated to about 700 deg. F. without showing corrosion or discoloration.

Practical Applications

Chromium plating is being successfully applied to replace nickel plating on automobile parts that are subject to weathering. While nickel plate tarnishes easily and wears off rapidly under successive polishing, chromium retains its brilliancy and needs only an occasional wiping with a cloth to remove dust. Due to its hard surface there is no danger of wearing or rubbing off the plate. Its application to parts of commercial machines is almost unlimited.

A practical application of the wearing qualities of chromium plate was found in the making of intaglio printing plates, the process of which was largely developed in the Bureau of Printing and Engraving at Washington. Formerly intaglio plates were made of steel and case hardened. The plates have to be highly polished after each printing impression and the severe abrasion makes them short lived. Soft steel plates are now plated with a coating of chromium about 0.0002 in. in thickness, and a greatly extended life of the plates has been obtained.

It is claimed that a wide application of chromium plating in the machine shop will be developed in the manufacture of gages. The working surfaces of gages are subject to continual abrasion in use and gradually lose their accuracy. Experiments have been conducted on the application of a thin coating of chromium to protect the surfaces of the gages. The plate is claimed to apply itself so smoothly that it does not require buffing or polishing. If present experiments are successful longer wearing life will be attained in one of the most expensive shop tools. In fact, the gages may be used over and over, since the chromium can be removed with hydrochloric acid when worn, and coated with a new plate.

The majority of chromium plating solutions have as constituents chromic acid, CrO_3, and chromic sulphate, $Cr_2(SO_4)_3$. The acidity of the bath is regulated by the addition of chromium carbonate or some similar compound. The preparation of the plating baths and the selection of anodes is not as simple as for ordinary plating. A high electric current density also must be employed, and the temperature of the bath must be well regulated. Another important feature of chromium plating is that the gases which are generated in quantity are injurious to the operators and require carefully installed equipment for their removal. There are now owners of patented chromium plating processes who either have installations for plating on contract for manufacturers, or install the equipment and license the use of the process. The cost of chromium plating is claimed to be not greatly in excess of nickel plating.

A deposit of 0.006 in. of chromium plate per hour has been obtained with the chromic acid type of bath. The plate can be applied either matt or bright. The matt deposit can be polished on a felt wheel. Chromium plating can be done on steel, nickel, copper, brass and most other metals. The first stages of chromium plating as practiced in one of the automotive plants are the same as those for nickel plating. The steel parts are polished, cleaned in a cleaning solution, and then copper plated, followed by another cleaning and a nickel plating. The ordinary buffing after copper plating is eliminated. After nickeling, the articles are buffed, cleaned and washed, and placed in the chromium plating tank. Only a cold water rinse is required after this operation. The chromium plate presents a high lustre without further polishing. Chromium over the nickel plate gives a clear blue-white finish of great brilliancy and reflecting power. Plating directly on steel does not give good protection, and to be an efficient rust preventer the coat must be perfectly adherent and must seal the underlying metal. If any part of the steel is exposed an electro-couple is likely to be set up, which accelerates corrosion. For this reason steel is usually first plated with copper before applying the chromium plate.

Wearing Qualities

Chromium plate is likely to find many uses in the protection of machine parts from wear as well as from rust. Valves and valve seats in pressure pumps handling water containing fine abrasive particles were plated with chromium and were found to last many times longer than the unplated ones. Chromium plating may also supplant the double operation of case hardening and nickel plating on many tools where resistance to wear and corrosion are both required, but where the structural strength of the case hardening is not needed. The many articles of builders hardware now made of brass, bronze, and nickel plated metals may also be largely replaced by chromium-plated steel. The frequent polishing given to these articles can be eliminated with chromium plate as it requires only to be wiped and retains its high luster for an indefinite period.

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Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

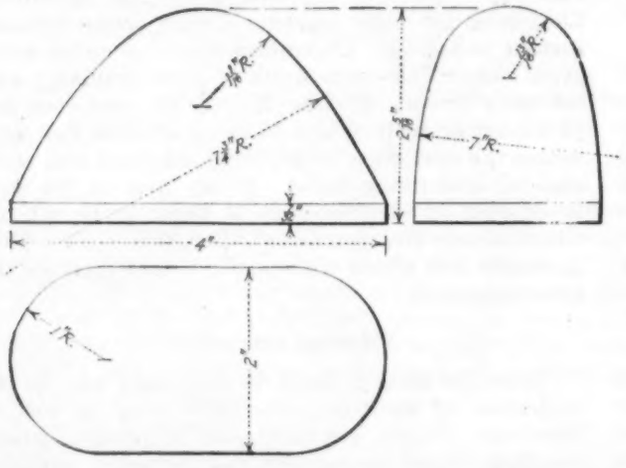
Drawing an Odd Shape

Q. I am enclosing a sketch of a shell for which I want to make tools. I have found nothing like it in any of the books or articles on die design. Can you tell me how this shape should be drawn? The material is 18 per cent nickel steel, with a thickness of 0.025 inch.

A. This drawing-die problem is an unusual and interesting one. If the part shown occurred in an ordinary commercial article, we believe that the average manager would study a way to redesign the part rather than to make the expensive tools required for producing it as it stands. We presume, however, from the shape and the type of steel, that it is a piece of ordnance, and cannot be changed.

It is probable that this shell can be made in three drawing operations. The first operation will produce a cup that is approximately a hemisphere, the dimensions of which will be largely governed by the action of the second operation. The depth of the cup should be about 1½ in., and the diameter will be somewhat greater than the periphery of the finished shell, which is 7.1416 in. in this case.

For the second operation the punch should be round,



but instead of being hemispherical on the end, it should nearly approach the curves shown in the end view of the shell. The shell, after having been trimmed from the first drawing, should be placed upside down on the second operation die and punched inside out. The rolling over action will prevent wrinkling, and will smooth out any slight wrinkles from the first drawing. You will now have a round shell with a center depth the same as that required in the finished shell, and with a top circumference equal to the periphery of the completed shell. The third drawing operation will elongate the shell to the required shape. If the correct amount of metal is left in the round shell it should not wrinkle in the final operation. You will be obliged to experiment back and forth with the shapes of tools for the first and second operation, and the completed set of dies may, therefore, be costly. However, the principles involved are not much different from those for producing a hemispherical shape.

Salvaging Diamonds from Truing Tools

Q. In an article in the American Machinist, *Vol. 62, page 394, on diamonds for truing abrasive wheels, a method of removing worn diamonds from the mountings by the use of acid was suggested. Can you tell us what acid was used for this purpose?*

A. The author of the article informs us that the diamonds which he reclaimed were the accumulation of several years, and they were mounted in various metals and alloys. The acids used in the plating room were used for the work. The procedure was to place the diamond mountings in a large tube and add the acid, heating up to about 150 deg. F. After about 24 hours in the acid bath the diamonds that were free were picked out and fresh acid was added. When one acid failed to act it was poured off and a second acid used. No attempt was made to find an acid that was universal for all mountings since the nature of some of the alloy metals was unknown.

The first acid employed consisted of 12 ounces of nitric acid in 10 quarts of water. The second solution was: Sulphuric acid 66 deg. Bé., 4 lb.; nitric acid, 40 deg. Bé., 1 lb.; and water 1 pt. The sulphuric acid is first added to the water, and then the nitric acid. A 20 per cent solution of sulphuric acid worked well on the steel mountings.

Surface Cracks in Dies

Q. We have lately experienced trouble from cracks in blanking dies. These cracks are fine hair lines and show up on top of the die after grinding. We are using a good standard quality of tool steel, and have tried various methods of hardening. Can you suggest where the trouble lies?

A. It is our opinion that the cracks are developed from too rapid grinding. Perfect tools are frequently spoiled by lack of attention to proper grinding. This occurs usually in shops where the toolmaker's responsibility ends when the die is turned over to other departments for heat-treating and grinding. Where the grinder operators are not skilled men the responsibility of the toolmaker for the die should be retained throughout the work. In your case the grinding of the dies is probably being done with too heavy a feed. The increase in surface temperature of the die will cause the cracks. The grinding of hardened tool-steel dies should be done with a very light cut and usually with a slow feed.

Technical Abstracts

Motor Plant Steps Up Production

The International Motor Co., Plainfield, N. J., has recently increased the production of four- and six-cylinder en bloc motors by the acquisition of flywheel lathes and automatic crankshaft lathes, and improvements to grinding equipment and in the heat-treating department.

On the flywheel job, performed in the Gisholt Simplimatic, the first roughing operation is: Turn, face and bore flange, face clutch fit, face hub, bore.

The second roughing operation is: Face second side of flange, bore crankshaft flange fit.

On the first finishing set-up the outside diameter is turned, the flange is faced and bored and the edge is rounded, the clutch fit is faced, and the hub is faced and bored.

Finish-machining of the second side consists of facing and boring the flange and boring the crankshaft fit. Also, the edge of the flange is rounded. Two men are required on four machines to produce at the rate of a finished wheel in 0.20 hour.

The same kind of machine is used in machining clutch disks, 21 in. in diameter, which are faced on the clutch side and turned to fit into the flywheel. On the second machine the back of the disk is faced and bored. The total time for the disk is 0.91 hour.

The turning of crank-pins is performed on LeBlond automatic crankshaft lathes. Each machine turns two pins. On the four-throw crankshaft, with the pins turned to within 0.003 in. of finished size, the time is 0.15 hour.

A crankshaft grinder has been equipped with a flexible-coupling drive in place of geared drive for controlling the movement from the master cam. No stoning of the nose of the cam is needed. The time is 0.55 hr. Tolerance limits have been cut 40 per cent.

Pistons are ground by the use of a standard grinder with narrow wheel, traversed over the face of the piston. The tolerances are 0.000 in. for roundness and —0.001 in. for taper.

Some of the heat-treating furnaces have been provided with a motor-driven pusher-bar loading device, operated by crank levers and gear reduction. The furnace is charged with successive loads of parts that are placed on an extension of the furnace bed and then pushed into the furnace by the pusher mechanism.—L. S. Love in *The Iron Age*, Aug. 19, p. 473.

Protecting Iron and Steel by Cadmium

It is generally recognized that a coating metal should have a higher solution pressure than the metal it protects, if it is to afford other than simple mechanical protection. Experience indicates, however, in the case of cadmium coatings that the cadmium behaves similarly to zinc in protecting iron from corrosion, although the electro-potential assigned to cadmium by most authorities would indicate the reverse.

Recent experiments made on mild steel specimens, having various metal inserts and immersed in a salt solution, show that zinc and cadmium are about equal in protecting power. Aluminum ranked next, while copper, nickel, tin, and lead showed no protecting effect electrolytically. The experiments also indicated that the potential difference between zinc and iron in contact in a salt solution is much greater than that between cadmium and iron under the same conditions.—Henry S. Rawdon in *The Metal Industry*, July, 1926, p. 276.

Safety in the Drop Forge Shop

Forge shops can be made safe and the workmen will welcome anything done. We think more of saving the man than the dollar, but when we save the man we also save many dollars. All shops have rules that hammers must be blocked while setting dies, but it is also necessary to provide proper blocks and have the foremen compel the men to use them.

The foreman in a board-hammer shop should not allow a hammer to run for five minutes without a box in place for catching broken boards. Injuries on cold trim presses have been reduced by removing all treadles. In order to get press men to keep their fingers from under the dies it is necessary to give both hands something to do while the ram is in motion.

No man is ever safe from eye injury in a forge shop unless he wears goggles all the time. The total of eye injury costs to the country is staggering. In six months during 1921 at the Dominion Forge & Stamping Co. eye injuries cost $3,234, but for the last half of the year following an order to wear goggles the cost was only $13, and from 1922 to 1926 there were no compensable eye cases.—G. A. Kuechenmeister, in *Forging, Stamping, Heat Treating*, Aug., 1926, p. 284.

Policies and Profits

Executives often give too little time to the study of design and production of their products, and the proper co-ordination of these important divisions of their industry. It is a simple matter for an executive to master the fundamental principles of processing, and be able to compare his production costs with similar parts on other products.

Analyses of company executives show that 90 per cent of industries are managed by men with outstanding ability in some one branch, and it is a regrettable fact that this ability frequently dominates the firm's policies. Many factories are controlled by men with exceptional sales ability who do not recognize the importance of production and design. Other factories are controlled by men of creative ability who have perfected a product of value, but who know little of marketing.

Take any product you manufacture and estimate in dollars or cents the cost reduction you feel you should be able to attain. Then multiply this by the quantities produced per year, and you will quickly realize the importance of better production methods and how quickly improvements will pay for themselves in profits.—A. C. Alexander, in *The American Machine and Tool Record*, June, 1926, p. 41.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

Established 1877

Spreading Good Will

THE Federation of British Industries and certain other organizations have launched a "come to Britain" movement for the attraction of foreign visitors to the British Isles. It is estimated that American tourists alone spend $350,000,000 annually in France and Great Britain, which is no small factor in the trade balances of the two countries.

As a nation we do not need to attract visitors to profit by their expenditures, but there is one point involved that is worth cultivation on the part of American manufacturers, and that is the possibility of spreading good will and business confidence through foreign visitors. Long distance sales, especially when handled through intermediaries, are often subject to misunderstandings.

The average American machinery manufacturer who does, or hopes to do, a business in foreign countries might do well to have his foreign agent visit the factory as often as the distance warrants. This is especially true of the Latin American buyer. To sell the South American one must compete directly against the best efforts of European machine builders on design, price, and service. Encourage the foreign agent to visit the plant and see how production problems are met to give him the best article at the lowest price consistent with the quality. He will go back as an enthusiastic apostle of your product.

Getting Engineering Service Free

ENGINEERING ability is behind our modern civilization. Without it we should still be using comparatively crude tools and the railroad, the automobile, the airplane and the radio would be unknown. And yet there is great aversion on the part of many to paying for the engineering ability that makes new devices possible.

Two examples of this recently came to notice. In each case a special machine was to be developed by the builder and in each instance the purchaser included in the order the provision that a set of drawings must accompany the machine. In other words, the customer asked the builder to design him a special machine, drawing on his wide experience to make it successful, and then hand over the drawings so that future orders could be given to a concern with no engineering expense or experience, at a lower cost.

The only justification for such an order would be the willingness to pay for the design in addition to the machine, and at a figure in proportion to its real worth. Instead, the purchaser expected to pay only a profit on the single machine, and have the plans thrown in.

In both instances, we are pleased to state, the order was returned. But unfortunately, shops will probably be found where such orders will be accepted.

Knowing Where to Go—and How to Get There

THE second Ford Air Tour has been completed in a manner that shows the reliability of commercial planes in daily service. The distance covered was approximately 2,800 miles with a definite schedule each day, the performance of each plane being carefully tabulated in every particular. Speed was not the main factor so that it was in no sense an airplane race.

The interesting feature of the contest was that the winning of the tour was not a matter of chance, of getting the "breaks," or of dare devil piloting. It was won because the navigator knew where to go and how to get there. In other words the leading plane won because it was fully equipped with the latest instruments for air navigation. Instead of following courses made up of railways and rivers, the pilot could ignore land marks just as a mariner does on the open seas, and head direct for his destination. With guesswork taken out of aerial navigation, commercial air travel will gain confidence more rapidly.

There is also a lesson for any machine business in the winning of the Ford Tour. Unless a business has its goal in view and a well laid plan for reaching it, there is grave doubt of success and unfortunately there are no ready-made instruments by which to steer the proper course. The manager, however, who studies his field, his equipment and his methods, will be much more sure of attaining success than the one who follows blindly the paths laid out by others.

One concern that is experimenting with stock ownership by employees has worked out some interesting details. Stock is sold only to those who have been with the company a specified length of time and who earn a given wage. If they leave the company the stock is exchanged from common to preferred, which has no vote, unless it fails to pay a dividend. All of which indicates the amount of thought that is being given to the problem of securing employee interest.

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Seneca Falls Automatic "Lo-swing" Lathe, Model R

The Seneca Falls Machine Co., Seneca Falls, N. Y., has added the model R automatic lathe, shown in Fig. 1, to its line of "Lo-swing" lathes. The machine was particularly designed for economical small-lot production. Although this lathe represents a radical departure from the standard machine, the same features of rigid construction and low swing has been maintained. The frame, head, and carriages are unusually heavy for a lathe of this capacity. Because of the compact design, the tool loads are placed almost directly over the ways without sacrificing chip room, and it is said that the lathe will handle a large number of heavy cuts without noticeable deflection. The compact design also permits the operator to load the machine without leaning too far over the work. The machine is fully automatic, and the standard cams used to control the feeds will handle a wide range of work. Flexibility is attained by rearrangement of the tools and by changes in the drive and feed pick-off gears.

The standard model R machine is designed to handle work between centers with the chuck driving on the flats, where present, or by self-locking and centering fingers in the case of round stock. Double-tail dogs can also be used for balanced drive. The spindle is hollow and it is possible to adapt the machine for handling bar stock. The lathe will swing work 6¼ in. in diameter over the carriage and will accommodate pieces up to 36 in. in length as pictured. With modified bed lengths, 15- and 60-in. capacity can be obtained. A longitudinal travel of 7½ in. and a cross-feed travel of 2½ in. is available on the front tool carriage. As in the standard Lo-swing lathe, provision can be made to take care of as many as fifty tools, where advisable.

The drive of the unit is by a single pulley and an all-geared head. Where motor drive is desired, the motor is mounted directly upon the head. The standard pulley is 15 in. in diameter by 5¼ in. face to accommodate a 5-in. double belt, and it has an outboard roller-bearing support. The pulley is mounted on roller bearings and drives the machine through a multiple-disk clutch actuated by means of a lever placed at the front of the machine. The pulley and clutch can be removed as a unit. The shaft on which the clutch pulley is mounted carries a pick-off gear on its other end. Power is transmitted to the spindle from this pick-off gear through two intermediate shafts, seen in Fig. 2. The first intermediate shaft, shown at the top of the picture, carries a pick-off gear that meshes with the one on the drive shaft. The second intermediate shaft is driven through one of two constant-mesh gears. The higher spindle speed is obtained by engaging a toothed clutch, in which case the low-speed gear on the second intermediate shaft revolves free. This action is made possible by means of a runaway clutch with a pawl release device, as on former Lo-swing models. The lathe spindle is driven through a single gear.

The pick-off gears are made of chrome-nickel steel, heat-treated. The driving pinion ranges from 27 to 56 teeth, while the driven gear ranges from 85 to 56 teeth. The other gears are also made of chrome-nickel steel and are heat-treated. They are 2¼-in. face and are of helical form to insure quiet running. The gear shafts and other important shafts are mounted upon roller bearings. The spindle, however, is mounted in tapered split bronze bearings that are adjustable for wear. The front bearing is 5 in. in diam. by 8 in. long, and the rear bearing is 3½ in. in diam. by 7 in. long. The spindle is a forging of 0.60-carbon steel ground all over. The thrust toward the head is carried on a roller thrust bearing adjusted by means of a flat thrust washer on the rear of the radial bearing sleeve. The gears and bearings are automatically lubricated by a gear-type pump.

A heat-treated chrome-nickel steel worm on the second intermediate shaft drives the feed mechanism

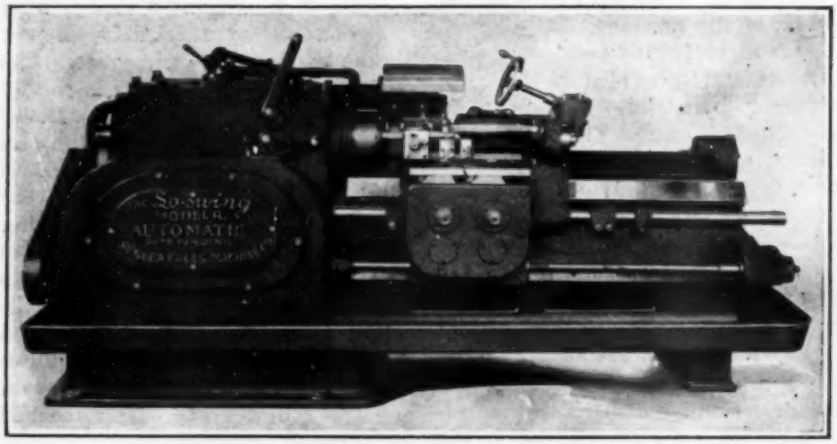

Fig. 1—Seneca Falls Automatic "Lo-swing" Lathe, Model R

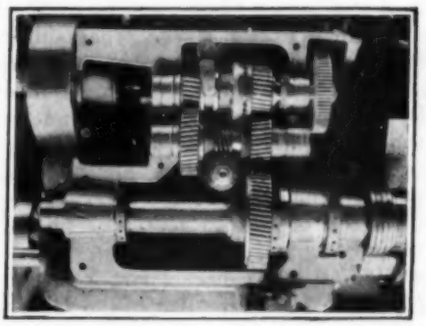

Fig. 2—Gear train for the main spindle drive

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through a vertical shaft, which in turn drives a horizontal shaft by means of a pair of bevel gears. At the end of this first countershaft and a second intermediate shaft is a pair of change gears that provides feeds ranging from 0.007 to 0.040 in. per revolution at the tool. These gears are exposed by removing a plate on the side of the head. A fixed gear on the second intermediate shaft drives a bronze-bushed idler gear incorporating a runaway clutch and mounted on the cross-feed spline-shaft member. This gear idles when the rapid traverse mechanism is engaged. This mechanism consists of a short shaft having at one end a pulley driven by means of a belt from the main drive shaft and at the other a fixed clutch member. The clutch member engages a similar but slidable part mounted on the main feed shaft, just mentioned, by means of a cam-operated lever. The rapid-traverse mechanism rotates at high speed and is also mounted upon roller bearings. On the opposite end of the main shaft is a universal joint for driving the spline shaft that passes through the carriage and controls the cross-feed motion of both the front and the rear carriages, while on the central part of this shaft is a worm that drives the front-carriage traverse mechanism.

This worm is mounted between two roller bearings and is made of chrome-nickel steel, heat-treated. It drives a bronze wormwheel and spur gear

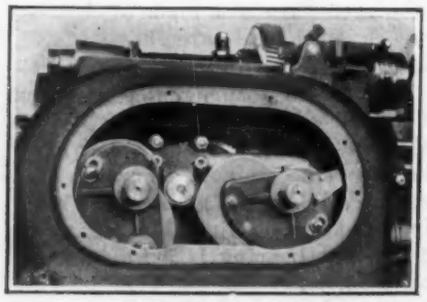

Fig. 3—Cams for controlling the front carriage traverse

unit mounted on roller bearings and revolving on a stationary stud. This central spur gear engages gears on either side mounted on the main traverse camshafts. The cams may be seen in Fig. 3. They are made of case-hardened and ground steel plates, and are dowel-pinned to cast-iron holders that are in turn triple-keyed to the camshafts. The camshafts are heat-treated and ground and are mounted on two roller bearings and a third bronze steady bearing in the rear of the head for supporting the unit when the front cover plate, together with the bearing housings, is removed as shown in the illustration. A case-hardened follower roller is placed between the cams and is positively driven in both directions. The follower rotates on a full-type roller bearing, the inner race of which is a hardened steel pin and the outer race the roller itself. The roller pin is carried on a bracket that is clamped to the carriage shifting bar, which oscillates back and forth according to the cam contour, but does not rotate. The inside cam carries a bar that upsets a ratchet at the high point of the cam and disengages the main clutch to stop the machine. At this point the machine is loaded. The cycle of the carriage is as follows: Rapid traverse to beginning of cut, low-speed feed to completion of cut, and rapid traverse to end position, where the machine automatically stops. The operator simply engages the clutch to start the operation.

The motion of the carriage is determined by the cams, but may be modified by stops placed along the traverse bar. Thus, dwell positions are available by means of air gaps between the stops and the carriage. The front carriage is mounted on a large V, faced with hardened and ground steel plates 3½ in. wide, and it is so located that the resultant tool load falls nearly on the center of the V. What tilting action is present is carried on a gibbed guide at the bottom of the carriage.

One or more independent cross-feed slides are provided on the front carriage. Two slides are shown in the illustrations. The drive is through a spline shaft, which passes through two quill-mounted worms carried on roller bearings. The worms are made of chrome-nickel steel, heat-treated, and two feather keys are used to drive them. Each worm engages a bronze wormwheel on a countershaft. A spur gear on the same shaft drives a quill-mounted cylindrical cam, which rotates on roller bearings. A roller carried on the cross-feed slide bears against the cam contour and is held in contact by means of a helical spring. The follower roller is hardened and ground and incorporates a full-type roller bearing, as in the case of the follower for the main cam. The cam itself is also case hardened and ground to prevent wear. The carriage cross-feed mechanism is lubricated by a pump driven from the spline shaft and bolted to the side of the carriage. It can be removed without disturbing any piping.

The back carriage movement is tied up with the front carriage mechanism by a bevel gear drive placed at the end of the spline shaft.

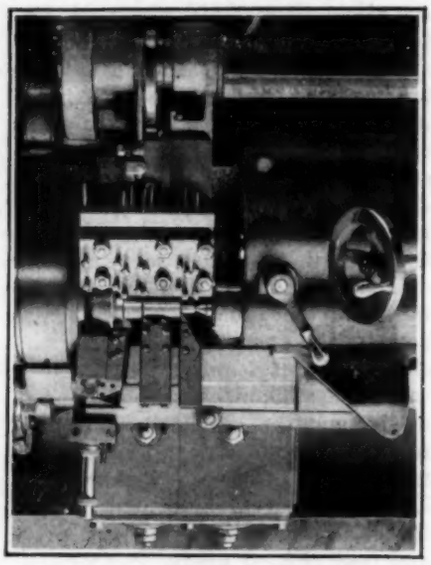

Fig. 4—Typical tooling set-up

An intermediate shaft placed in an inclined position transmits the motion to a back shaft through a worm and wheel. The motion of the rear cross slide is obtained by means of a cam. A heat-treated spur pinion placed on the back shaft drives a gear on the end of the cam shaft. The cam is of the disk type and is rigidly mounted between centers. Roller bearings are used to support the cam shaft. The carriage slide bears against the cam through a roller that is maintained in position by spring pressure. A positive pull back is also provided to return the cross slide rapidly. This construction is indicated in Fig. 4, which also shows a typical tooling set-up for an automotive third member. Both the cam and the follower are case hardened and ground.

Since the feed mechanism for the

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rear carriage is tied up with the front carriage, both can be rapid traversed subject to the same cams. The control cams are located on an extension of one of the main camshafts for the front carriage traverse. These cams are located outside of the head housing for ease of adjustment, but are fully protected from abuse by the overhang of the case.

The tailstock has been radically redesigned. The way on the bed has been considerably widened and tilted at an angle. The tailstock is gibbed in place under the front V. The center is live and is mounted on roller bearings in a sleeve 4½ in. in diameter. The center-point is a standard No. 4 Morse taper. The handwheel that controls the movement of the sleeve is mounted on a geared shaft in such a position that it is within easy reach of the operator, as can be seen in Fig. 1. A bracket is bolted on the front of the tailstock for use with a taper cutting attachment, where desired.

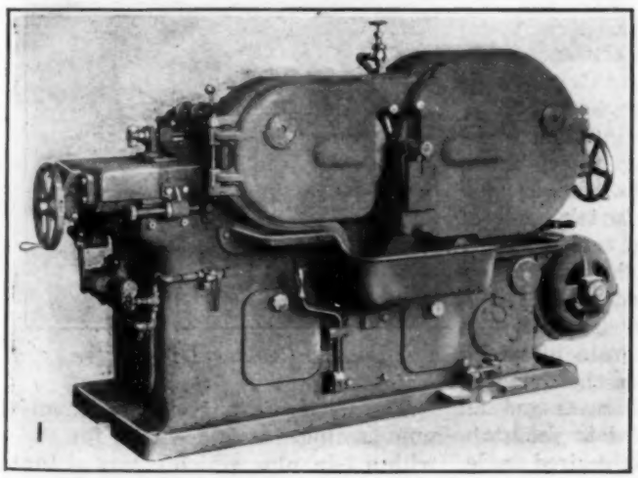
The head and bed of the machine are cast in one piece and are of unusually heavy construction to resist distortional stresses. The bed is well ribbed. The way for the tailstock and the rear carriage is chilled. The coolant reservoir is located in the base of the machine under the head. A dam separates the pump sump from the settling compartment. The coolant pump is driven by means of a belt from the drive shaft. It is of the centrifugal type, and it has a capacity for 75 gal. per minute.

Heim Centerless Grinder, Improved

The Heim Grinder Co., Danbury, Conn., has developed an improved centerless grinding machine. A front view is shown in Fig. 1 and a rear view is shown in Fig. 2. The chief feature of the improved machine is the use of an hydraulic control for the regulating-wheel slide. This control is used in spot or infeed grinding, and it is said to eliminate all waste time in the movements of the regulating-wheel slide. There is also an hydraulic control for the truing diamonds by means of which the diamonds may be fed uniformly at a fast rate across the wheel or with an almost imperceptible movement. Other improvements embodied in the machine include "Texrope" drives to both the regulating wheel and the grinding wheel, a quick-change gear box, visible settings, and simple adjustments. The machine is of greater capacity than previous models, and it will accommodate work ranging from ⅛ to 6 in. in diameter. In through-pass grinding, bars of any length can be handled and in spot grinding, work up to 8 in. under the head can be ground.

A 15-hp. motor mounted on the right-hand end of the base drives the machine by means of a silent chain. A Carlyle-Johnson friction clutch is mounted upon the driven shaft and is operated by means of a foot treadle on the front of the machine. The motor is mounted on a hinged bracket so that the tension of the driving chain can be adjusted. A 5-groove sheave is mounted on the driven shaft and drives a similar sheave on the grinding-wheel spindle by means of five Texrope strands. There is also a sprocket on the driven shaft that transmits power to a quick-change gear box through a silent chain. The same chain also drives the pump for the hydraulic system. A 3-groove sheave is mounted on the shaft driven from the gear box and it drives a similar sheave mounted on the regulating or work-rotating spindle by means of three Texrope strands. Power is also delivered from the gear box by means of a sprocket and a chain to a shaft running along the back of the machine near the top. On the right-hand end of this shaft is a cam and lever mechanism for actuating the hydraulic control valve for the regulating (or work-rotating) wheel slide.

By means of a simple valve adjustment, strokes of various length and speeds can be obtained for the regulating-wheel slide by shifting the position of the levers on the front of the gear box. Either 2, 3, 5, 9, 15, or 25 reciprocations of the slide per minute are obtainable. There are seven regulating-wheel speeds, including the truing speed, of 8, 13, 21, 37, 62, 100, and 740 r.p.m. With this range of speeds and feeds, it is said that the regulating wheel can handle all grinding conditions on work of any material of a size within



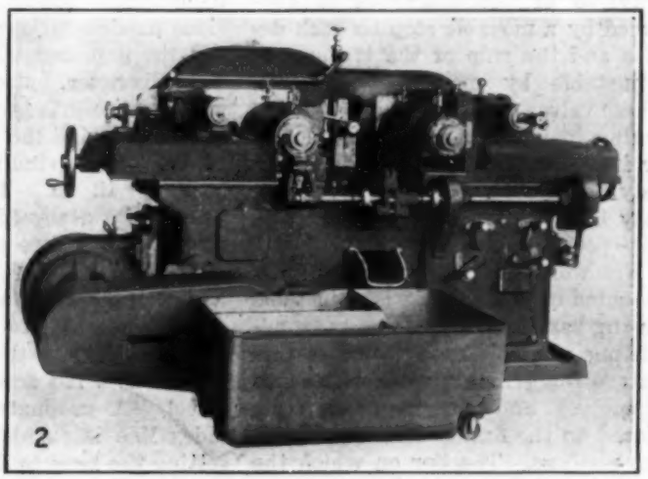


Fig. 1—Heim Centerless Grinding Machine Improved. Fig. 2—Rear view of the machine

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the rated capacity of the machine.

In spot grinding, the cam that controls the hydraulic system gives a slow feed to the regulating-wheel slide until the wheel reaches the necessary position for grinding to the required diameter. Then the wheel dwells for a short period in that position and is finally given a quick return to the starting position. The hydraulic cylinder for the regulating-wheel slide is mounted on the inside of the base and the piston in the cylinder acts as a feed nut for the slide adjusting screw. This screw is fastened to the slide. An adjustable stop on the slide is set to contact with a stationary stop on the front of the bed, when the regulating wheel reaches the proper grinding position. At this point, the hydraulic pressure is by-passed through a relief valve. An adjustment on the control valve permits the volume of fluid entering the valve to be regulated so that variations in the speed of the slide travel can be obtained.

When the machine is set up for through-pass grinding, the piston in the hydraulic cylinder of the regulating wheel slide is held in contact with one end of the cylinder so that it simply acts as a fixed feed-nut that permits adjustments of the slide. For in-feed or spot grinding, the grinding wheel slide is locked to the base by a cam-lever that can be quickly released when adjustments are required.

The diamond truing devices are reciprocated automatically across the faces of the wheels by means of the hydraulic system. The length of traverse of the diamonds is governed by a movable stop on each device and the rate of the traverse is adjustable by means of a valve. These valves are arranged so that the truing may be operated individually or in unison. The truing diamonds may be adjusted for taper work and may be equipped with a guide plate for special form work.

The work-holding fixture is rigidly mounted on a slide that is adjustable on the base of the machine. An adjusting screw is used to locate this fixture for grinding work of various diameters and a graduated scale placed on the fixture slide facilitates the settings. The bar on which the work is fed is provided with a surface of Stellite to resist wear. A single fixture is suitable for feeding a wide range of work. In spot grinding, the fixture is supplemented by a cam-actuated bar at the rear of the machine that is used to eject work as it becomes finish-ground.

Means are provided for oscillating the grinding wheel spindle a slight amount in spot grinding, where an extremely fine finish is required. This oscillation is derived from the same mechanism that actuates the regulating-wheel slide, so that the

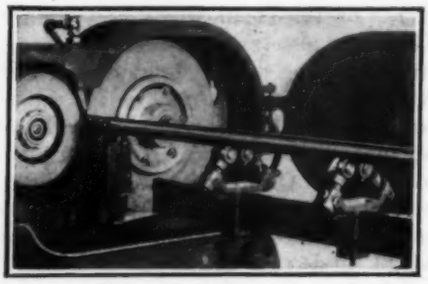


Fig. 3—Outboard supports for use in grinding long bars

movements of both wheels are made in the proper sequence. A vertical lever located at the front of the machine is used to change the rotation of the regulating wheel from a working speed to a truing speed. Both wheel spindles are provided with self-aligning ball thrust bearings. These bearings are completely enclosed and are properly lubricated. The positions of the grinding wheel and the regulating wheel can be closely adjusted by means of a hand wheel at the outer end of their respective slides. Both hand wheels have graduations on their rims to thousandths of an inch. On previous machines the regulating wheel and the grinding wheel were of the same diameter, but on this improved machine the grinding wheel is 24 in. in diameter and the regulating wheel 14 in. The grinding wheel has a bore of 12 in. The sleeves and flanges are designed to take care of wheels of any face up to 8 inches.

The spindle of the regulating wheel can be swiveled from 1 deg. above horizontal to 6 deg. below in order to change the rate at which the work is fed across the grinding wheel. A graduated scale and an index line is furnished to facilitate setting the head to the desired angle.

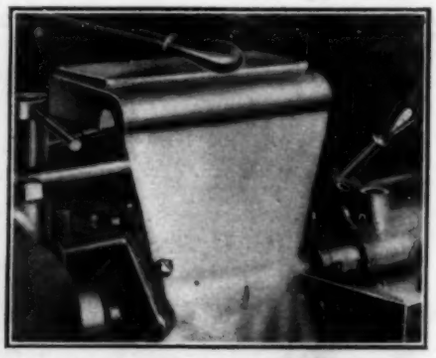
All units, such as the quick-change gear-box and the pressure tank of the hydraulic system, are contained within the base. They are mounted in such a manner that any unit can be removed intact. The coolant is delivered to the wheels and the work by means of a centrifugal pump fastened to the front wall of the base. All coolant is drained from the work to a tank, which is mounted on wheels so that it can be readily removed for cleaning. The tank is provided with three settling compartments. Telescopic guards on the wheel slides and a trough that extends across the machine are used to exclude the coolant from the inside of the base.

When the machine is used to grind long bars, outboard supports are furnished to supplement the work-holding fixture. These supports, shown in Fig. 3, are adjustable vertically and are equipped with sets of trunion rollers mounted on adjustable brackets. These rollers can be swivelled on their axes to the angle at which the regulating wheel of the machine is inclined.

The machine occupies a floor space of approximately 5 x 9 ft. The weight of the unit without the motor is about 7,500 pounds.

Goulds Coolant Distributor

The coolant distributor illustrated is being marketed by Goulds Pumps, Inc., Seneca Falls, N. Y. The device consists of an inclosed tray with suitable baffles for producing an even flow of liquor over the lip, which is in the form of an elongated spout.



Goulds Coolant Distributor

The device is a two-piece aluminum casting. It is designed for use with a 1-in. pipe, which enters at the bottom near the rear and acts as a support for the distributor.

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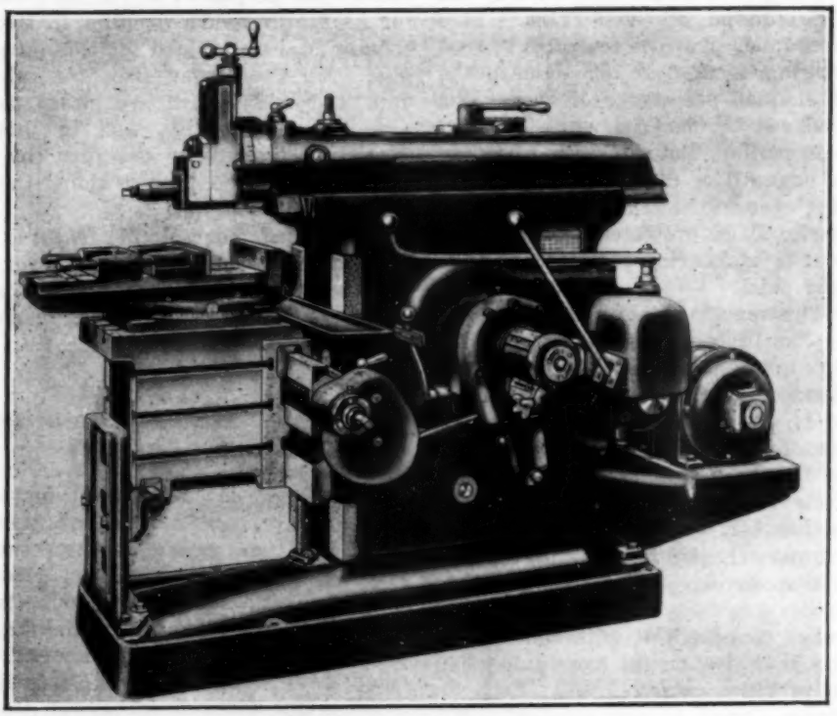
American "Auto-Oiled" Shaper

The American Tool Works Co., Cincinnati, Ohio, is marketing the improved "Auto-Oiled" shaper illustrated. The machine has been increased in both weight and power, and an automatic oiling system has been provided. Many other changes have been made to essential parts of the machine.

In order to avoid a loss of power, the number of gears and shafts has been reduced to a minimum. All high-speed shafts are mounted upon Timken tapered roller bearings. The drive is through a four-speed gear box attached to the shaper column at the rear. One long lever is used to select the speeds. The gears are cut from chrome-manganese forgings, and are heat-treated, oil-tempered and hardened, and are mounted upon multiple-splined shafts. The shafts are also made of heat-treated alloy steel and are mounted upon roller bearings. The bearings and gears are flooded with filtered oil through the automatic lubricating system, and in addition the gears run in a bath of oil.



American "Auto-Oiled" Shaper

Power is delivered to the gear box through a multiple-disk clutch incorporated in the speed box. The clutch is composed of hardened steel disks that run in oil. It is operated in conjunction with a brake actuated by a toggle lock. The clutch-brake unit is controlled by one long lever extending to the front of the machine.

The back gears are located inside the column, and by means of them two additional speeds can be obtained. The gears are of the helical type and are mounted upon tapered roller bearings. The gears are made of the same material and receive the same treatment as those of the speed change box. The bull wheel, however, is not hardened. Owing to its size, it is made from a semi-steel casting. Both this bull gear and the pinion that drives it are of the helical type. The bull wheel is built in two pieces, the gear portion being bolted to a large hub or disk. This design was adopted in order to facilitate repairs. A gear guard is placed over the bull wheel to prevent chips and foreign matter getting between the gear teeth. The hub of the bull gear is large to give the unit a substantial mounting in the column bearing. The hub rotates on a renewable bushing and is flooded with oil. The mounting of the unit is high up and close to the column wall, so as to bring the power application as close as possible to the ram.

The rocker arm is of box form and is heavily ribbed. It is made of a 25-per cent steel, close-grained cast iron, and is of high tensile strength. The fulcrum of the arm is journaled in both of the column walls at the bottom. The rocker arm is connected to the ram through a double link, designed so as to pull the ram down on its bearings during the entire cutting stroke and to neutralize the upward thrust of the tool. The sliding block is made of alloy steel, hardened and ground and fitted to the ways of the rocker arm which have been chilled at this point. The block is made long in order to prevent wear. The wrist pin that revolves in the sliding block is also made of an alloy, heat-treated steel and is furnished with a renewable hard bronze liner. All of these parts receive flood lubrication.

The ram is of the "V" type and is provided with wide guides in order to assure a large area of bearing on the column ways. A combined clamp and gib is provided to take up wear. The gib is fitted between the ram and a heavy vertical wall for absorbing thrusts, and is adjusted by means of a series of screws. Any lifting tendency or end motion under cuts is prevented by two large studs. The ram is ribbed internally to insure rigidity. It is automatically lubricated.

The ram ways in the column are reinforced and the bearing surfaces are chilled. The guide ways are fitted with felt inserts connected with the automatic lubricating system, while at each end of the ways a felt wiper is located to prevent the oil from escaping. At the same time, the wiper removes grit or dirt from the ram bearing. The column itself is wide and deep and is reinforced with radial and lateral ribs in order to obtain the necessary rigidity. The base has been increased in size and has been extended to the front of the machine so as to provide a pad for the table support. Tne reservoir for the oiling system is contained in this base.

The cross rail is of box form and is heavily ribbed. It is of such

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length that the table has a long horizontal range of travel. Three wide bearings are provided for the apron. The rail is bolted to the column by means of clamps and bolts of improved design. The elevating screw is of large diameter and the thrust on the nut is taken on a ball bearing. The screw is stationary so that no holes in the floor are necessary to accommodate its travel.

Table Construction

The table is made in a complete box section in order to prevent deflection when heavy work is bolted on its side. It is fitted to the narrow guide-way on the rail with a dovetail fit at the bottom and a square box fit at the top. The table is supplied with horizontal T-slots on the two sides and on the top. The slots are all planed from the solid. Felt wipers are used to clean and lubricate the top bearings between the table and the rail, while a full length tapered gib with end screw adjustment is used to maintain an accurate fit between these two members.

The top of the table extends over and bears upon the top of the apron, so as to prevent dirt working down between the table and the saddle. This construction is said to remove the strain from the clamping bolts in addition to adding considerable surface to the table. A dirt guard of pan construction is also fastened to the rail to catch chips and dirt that might otherwise work into the bearings.

A supporting block is provided for the table that is always in contact with it, even when the feed is in extreme position. The upright housing is bolted to the base, and it carries an adjustable support block, on which the table rests. Felt wipers are supplied to lubricate and cleanse the contacting surfaces of the table and the support block.

The vise can be furnished with either single or double screws. In either case, the jaws are deep and are faced with annealed tool-steel plates. The vise body is clamped to the swivel base, which is graduated in degrees. The base itself is held on the table by means of four T-head bolts.

The cross feed for the table is automatic and is said to be simple in operation. Nine speeds can be selected by means of a star knob located on the bull wheel unit. It actuates a pointer along a graduated scale, which is in view of the operator at all times. The feed is engaged, disengaged, or reversed by means of a lever on the cross rail unit. The feed takes place during the entire return stroke of the ram. An automatic safety mechanism protects the feed works against damage in case the tool is accidentally fed into the cut or the apron fed into either end of the cross rail. The feed screw is fitted with a micrometer collar graduated to one thousandths of an inch. The tool post is made of case-hardened steel and is proportioned to accommodate tool holders with inserted bits.

Power Feed on Tool

The power down-feed on the tool slide can be provided extra. This mechanism provides ten rates of feed ranging from 5 to 50 thousandths of an inch per stroke of ram. The feed can be changed while the ram is in motion, and the mechanism can be engaged or disengaged by means of a lever on the ram just back of the head. It is protected against accident by a shearing pin located in the feed pawl.

The machine is regularly driven by an electric motor connected through a short belt. The recommended speed of operation is 1,800 r.p.m. for the motor. The motor is mounted on a bracket or base bolted to the shaper column and is connected to the driving pulley by an endless belt with a ball bearing idler, counterweighted to maintain tension. The motor drive is inclosed in a dirt-proof housing. A tight-and-loose pulley countershaft with roller bearing mounting on the loose pulley can be provided extra.

Lubrication

The oiling system is such that every bearing, gear, and fast-moving part including the ram guide ways are constantly flooded with filtered oil. It consists of a large oil reservoir in the base with a settling compartment where the heavy sediment is deposited. The settled oil flows to a second compartment, where it enters a plunger pump and is forced to the filtering and distributing tank at the top of the column. From the upper tank the oil is forced by pump pressure through felt pads and then distributed to all the bearings.

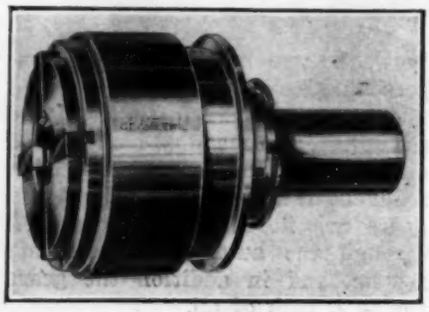
Only one operation is necessary to change the stroke of the ram. An automatic clutch-lock is released by the application of the stroke-crank to the end of the stroke-adjusting shaft. This mechanism automatically locks upon removal of the stroke-crank. The stroke-adjusting crank will not stay in place unless held there; hence, the locking device cannot be left open through carelessness. A straight scale is provided along which a pointer travels to indicate the stroke length as the adjustment is being made.

On all sizes below the 24-in. "Heavy Pattern" the rocker arm is made with a double section at the top, so that fairly large diameter shafts may be passed under the ram for keyseating. An opening in the column is also provided for this purpose. On the larger sizes the column and rocker arm are closed to give greater rigidity, and in this case the column is so designed that the shaft can be passed along the front of the column.

Centralized control is featured. The clutch lever, the gear shift lever, and the feed change mechanism are all located within convenient reach of the operator.

Geometric Rotary-Opening Diehead, Style KD

In order to meet the need for a flange-trip type of diehead that will trip every time at exactly the point set, the Geometric Tool Co., New Haven, Conn., has brought out its Style KD rotary-opening diehead. This tool is claimed to be specially adapted to shoulder threading, and is designed for use on all of the



Geometric Rotary-Opening Diehead, Style KD

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principal screw machines, turret lathes, drill presses, and threading machines.

The diehead is shown in the accompanying illustration. It is opened and closed by a single yoke. The features claimed for the Style KD diehead are: Quick release for removing and inserting chasers; complete inclosure with no pockets for chips or dirt; large chip clearance; large range of diameters with one size of head; and no overhang or screws to interfere with shoulder threading.

The chasers used in the KD diehead are interchangeable with those for the corresponding sizes of K dieheads. The chasers can be removed without the use of a screw driver. The Style KD head is made regularly in five sizes, $\frac{7}{16}$, $\frac{5}{8}$, 1, $1\frac{1}{4}$ and $1\frac{1}{2}$ in. Other sizes can be obtained to meet particular requirements.

Universal Circular Tables for "Société Genevoise" Jig Boring Machines

The Société Genevoise D'Instruments de Physique, of Geneva, Switzerland, has developed two sizes of universal circular tables for use with their high-precision locating and jig boring machines. This equipment is being marketed in this country by the R. Y. Ferner Co., Investment Building, Washington, D. C. The smaller of the tables, illustrated in Fig. 1, is for use on the No. 4 machine, while the larger table, illustrated in Fig. 2, is intended for use on the Nos. 5 and 6 machines.

It is claimed that with the aid of these tables, holes can not only be laid off and drilled on workpieces in

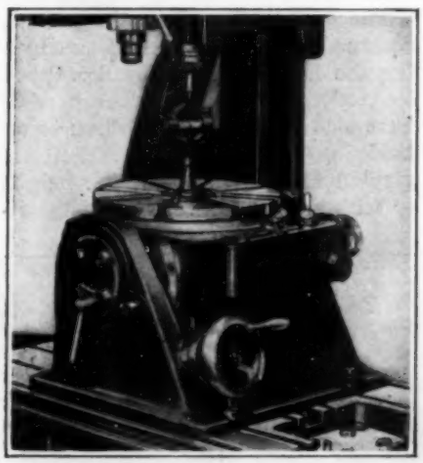

Fig. 1—Universal Table for "Société Genevoise" Jig Boring Machines, Small Size

the horizontal plane, as with the regular circular table supplied with these jig boring machines, but holes can also be bored on different faces of the same piece, either parallel, radial, or obliquely radial about the central axis of the workpiece.

In both cases the dividing table revolves about a long central pivot of sufficient size to resist deformation when the table is subjected to the stress of the drilling or boring tool. It is provided with a clamping device. The rotation of the table is controlled by means of a worm screw, fitted with a reading drum, graduated to 20 seconds of arc, while a vernier permits estimation of one second of arc.

The table is set on a horizontal plane, and its upper surface may be set to any angle from 0 to 90 deg. This angle is measured by an accurate graduation with a vernier reading to one minute of arc. On the small table the reading is made by means of a magnifying lens. In each case the tilting of the table is accomplished by means of a worm screw, to facilitate careful setting to the correct angle. Four strong clamping keys serve to hold the table at the desired angle. On the large table fixation pins are also provided for holding the table in either a horizontal or a vertical position. Special keys are provided for the correct lining up of the fixture on the table of the jig boring machine so that the horizontal axis is perpendicular to the direction of motion of the table of the machine.

In order to accurately locate the center of the table with reference to the axis of the spindle of the machine, a spherical-ended center pin is supplied for insertion in the taper hole of the axle of the dividing table, and a level is fitted between the spherical end of this pin and a center mounted in the spindle. The distance between the center of the spherical end of the pin and its shoulder is accurately known, so that in locating the fixture with the dividing table set vertically or obliquely a definite allowance can be made for this distance, in determining the point at which to drill the hole in the workpiece.

In order to obtain the setting at which to start the hole when the table is in an oblique position, it is necessary to make a simple calculation by means of a formula that involves the tangent of the angle at which the table is set, and the specified height of the hole to be drilled above the lower surface of the workpiece. It is recommended that this calculation be made in advance by the draftsman, so that the workman can locate the holes with rapidity, once he has obtained his zero setting.

When holes are to be located on the sides of a workpiece, such as on the face of a hexagonal piece, two methods of determining the point for boring are available. The first method involves the use of the

Fig. 2—Universal table, large size

spherical-ended center pin and level as described above but without the use of trigonometrical computations. With the alternate method, the work is clamped directly to the table in the vertical position and the upper surface of the workpiece is located beneath the spindle by means of a reference square regularly furnished with the machine for direct reference to the edge of a workpiece. It is used in conjunction with the prismatic microscope, supplied as an accessory. This microscope can be mounted in the spindle of the machine with the intersection of its cross hairs coincident with the axis of the spindle. The tool is then positioned by turning the leadscrew of

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the table of the machine the amount required to move from the surface of the workpiece to the point at which the hole is to be located.

It is claimed that due to the ease with which holes can be laid out, drilled, and bored on this machine, that the machine is useful for development work and model-making as well as for jigs and fixtures. It is also said that the attachments will aid in carrying out new designs, or in the preparation of special gages, or the inspection of the finished product.

The small dividing table has a diameter of 11¾ inches, the base is 15½ x 17 in. in size, and the large table is 17¾ in. in diameter, and the base is 23 x 17½ in. The height of the dividing table above the carriage of the machine for the smaller size is 11½ in., and for the larger size is 15 in. The net weight of the smaller table is 300 lb. and of the larger 425 pounds.

Diamond Face Grinder, Large Size

The Diamond Machine Co., Providence, R. I., has developed what is claimed to be one of the largest and heaviest grinders ever produced. It is designed primarily for grinding railroad frogs, but can be used for any similar work where the grinding of flat surfaces is required. It is claimed that the time for grinding a frog with this machine is about 30 min. The machine handles work up to 198 in. in length and up to 42 in. in height.

The bed is 336 in. in length, and has a three-point bearing on the floor. The table is carried on the bed on a 90-deg. V, 4 in. wide, at the front, and a flat way at the rear 5 in. wide. The table is 258 in. long and 36 in. wide. The platen measures 200 x 36 in. and has seven T slots for use with ¾-in. bolts. The first slot is 3 in. from the wheel, and thereafter the spacing is 5 in. Three drains are provided in the table for removing the coolant. The rack on the table is 2½ in. wide and is driven through a gear train having cut steel gears. The table can be traversed by either hand or power and is controlled from both the front and the rear of the machine.

The wheel chuck holds 24 abrasive blocks, each of which is 7¼ in. deep by 2 to 3 in. wide. The segments are adjustable for wear and more than 5 in. of the depth can be removed before the block needs to be removed. A permanent wheel-truing device is fastened to the upper wheel guard of the machine, so that the wheel can be trued while grinding.

The wheel rotates at 215 r.p.m. The bearings are split phosphor-bronze bushings 22 in. and 14½ in. long, respectively. The spindle is 9 in. in diameter at the front bearing and 7 in. at the rear bearing. Ball thrust bearings are used to take the grinding thrust. The wheel head may be fed by hand from either the front or the rear of the machine, and it has a total travel of 4 in. Automatic cross feed controlled from the rear has a range from 0.001 in. to ⅜ inch.

The machine is driven by a 75-hp., 50-deg. type motor that runs at 735 r.p.m. The motor drives the spindle by means of a sprocket and a silent chain, 10 in. in width. Suitable guards are provided. The table is traversed by means of a cross belt 2½ in. wide.

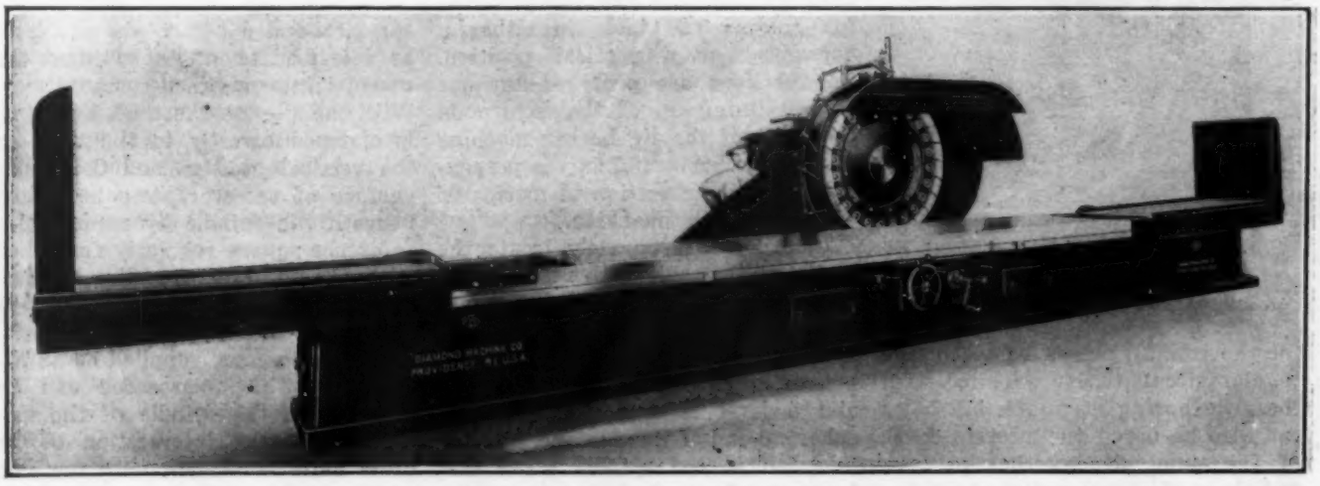
The coolant pump is motor driven and it provides 100 gal. of water per min. The main tank of 100 gal. is used in conjunction with a settling tank of 40 gallons. The nozzle directing the coolant to the wheel is adjustable as to position and opening.

The machine occupies a floor space of 10 ft. 7 in. by 55 ft. 9 inches.

Zeh & Hahnemann "Reclinable" Power Presses Type 36

The Zeh & Hahnemann Co., 182 Vanderpool St., Newark, N. J., has placed on the market an improved line of "reclinable" power presses to supersede the inclinable presses previously marketed by this firm. The Type 36 press is shown in the accompanying illustration.

The improved presses have been designed to afford greater strength for the heavier dies now demanded by modern production. The presses have also been made to recline to an angle of 40 deg. The frame is pivoted in front, so that the height of table remains the same in all posi-



Diamond Face Grinder, Large Size

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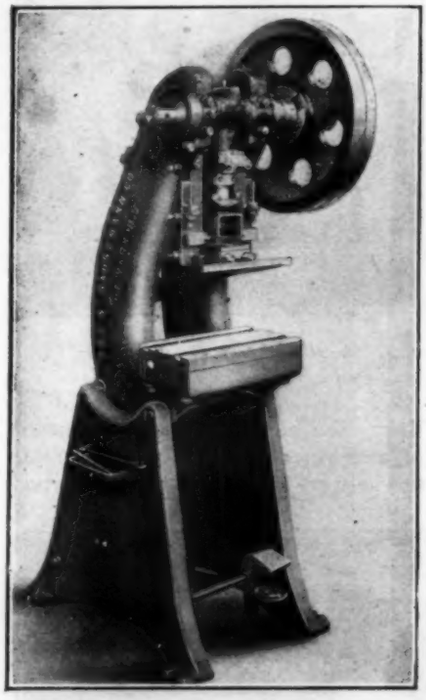
tions. The reclining mechanism is made to work easily, and the frame is positively supported by an elevator screw.

The clutch of the No. 36 presses is of the non-repeatable, or single-stroke, type, and it is claimed that the ram will not make a second stroke even if the operating treadle is not released. If it is desired to use the press for continuous work, such as blanking, it can be accomplished by throwing over a small lever. A finger guard is also provided for additional safety, and a treadle guard protects the treadle against falling pieces that might cause an accidental stroke. The latter also affords a rest for the operator's foot.

The flywheel is of the disk type for greater safety. The larger sizes of presses have a releasing brake which acts only during the required part of the stroke. Lugs for tierods are provided on the larger presses, making them suitable for heavy stamping work. Presses are furnished with an adjustable stroke on special order.



Zeh & Hahnemann Reclinable Power Press, Type 36

The Type 36 "reclinable" presses are built in seven sizes: Nos. 2, 3, 4, 4½, 5, 6, and 7. By squaring the number the normal capacity of the press in tons is obtained. The size 5 press, for example, will exert a pressure of 25 tons. All presses are tested at an overload of 50 per cent before leaving the factory. The net weight of the smallest size, No. 36-2, press is 650 lb., and the floor space occupied is 24x28 in. The weight of the largest, No. 36-7, geared press is 7,000 lb., and the floor space occupied is 52x60 inches.

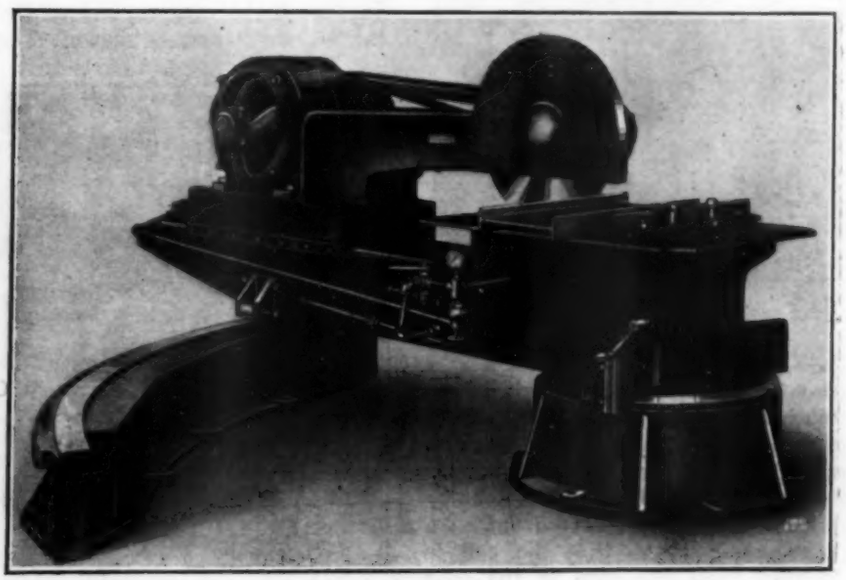
Hunter High-Speed Metal Cut-Off Saw No. 2

The No. 2 high-speed metal cut-off saw, illustrated, was developed by the Hunter Saw & Machine Co., Pittsburgh, Pa., for the rapid cutting off, mitering, and coping of the new Junior beams, and other similar sections, such as stair stringers and various pressed and rolled metal sections. It is claimed that a 12-in. Junior beam can be cut off in 5 sec., and a 6-in. Junior beam can be cut off in about 3 seconds.

The machine is mounted upon a turntable which permits it to swing to any desired angle, so that angular cuts can be conveniently made on beams 50 or 60 ft. in length. The table is rotated by means of a crank handle at the front end of the machine. The motion is transmitted through a pair of reducing bevel gears to a spur pinion meshing with the gear sector on the outer edge of the track. When the table is set to the desired angle, it is clamped in place at the central, pivotal stand by means of a crank.

The machine is equipped with a 24-in. toothed saw, belt driven directly from a motor. The motor and saw unit are mounted on a carriage that is equipped with rollers. The power feed is obtained by means of a hydraulic system. The piston-rod of the hydraulic cylinder is attached directly to the saw carriage. The hydraulic pump and its driving motor are mounted upon the machine, so that the unit is completely self contained. Both this motor and the saw motor are controlled by means of push buttons conveniently located.

The saw arbor is mounted on double-row deep-groove ball bearings contained in oil-tight and dust-proof housings. The belt and saw blades are protected by steel guards to conform with safety specifications. The belt guard can be quickly removed and an endless belt applied without dismantling other parts of the machine. The motor is mounted upon an adjustable base for obtaining the desired belt tension. It is rated at 15 hp. and any standard make can be supplied to operate on any circuit or voltage desired.



Hunter High-Speed Metal Cut-Off Saw, No. 2

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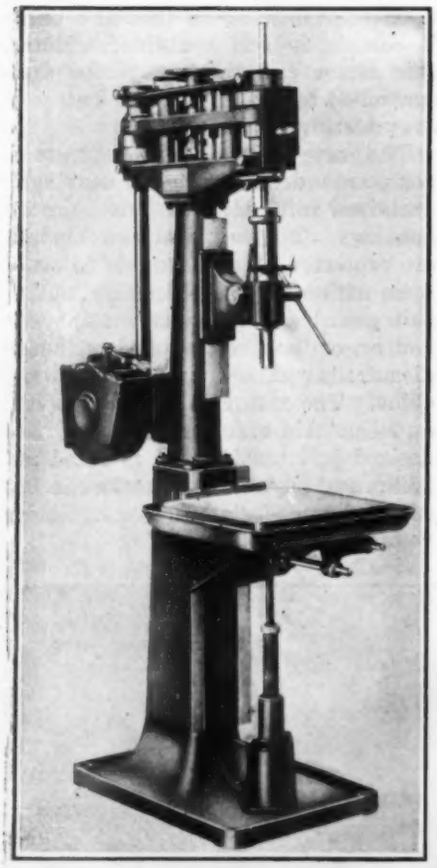
Fosdick High-Speed Sensitive Drills, Nos. 3 and 4

The Fosdick Machine Tool Co., Cincinnati, Ohio, has added to its line of drilling machines the Nos. 3 and 4 high-speed, ball-bearing sensitive drills. The No. 4 machine is shown in the accompanying illustration. The No. 3 bench type machine is built with 1 to 4 spindles, and the No. 4 pedestal type is supplied with 1 to 6 spindles. Both types of machines are built in 16 and 24-in. sizes, with capacity for drilling ¾-in. holes and for tapping ¼-in. holes.

All revolving parts of the machines are equipped with ball-bearings of standard design protected with dust-proof oil retainers. The belt-driven machines are furnished with a tight and loose pulley, and a swiveling belt guard and shifter.



Fosdick High-Speed Sensitive Drill, No. 4

The shifting of the belt is done by means of a central cam drum on a four-step cone, so that the belt is shifted from one step of the cone before it is advanced to the other cone. The tension of the belt is relieved automatically by an idler cam before the belt is shifted. The drive is through spiral gears running in oil. The table has a large oil channel for chips and lubricant.

The table on the No. 4 machine is adjustable on the pedestal by means of telescopic screws, and can be elevated, lowered, or clamped in position by the lever in front. The head is adjustable on the column, and can be clamped securely in position. The spindles and sleeves are of high grade steel, and all other parts are claimed to be designed to meet the requirements of the latest high-speed drilling practice.

Lake Erie Horizontal Plate-Bending Roll

The Lake Erie Engineering Corporation is marketing an improved type of horizontal plate bending roll illustrated in Fig. 1. The machine is of the pyramid type and was designed especially for boiler-plate work. As shown, the machine will handle plate 16 ft. wide by 1¼ in. thick. A larger machine for handling plates up to 20 ft. in width is contemplated.

The rolls are made of forged steel. The two bottom rolls are 16 in. in diameter and are fitted with lining grooves for squaring the plate. Intermediate steady-rest trunion rollers are used to minimize deflection under load. The top roll is 23 in. in diameter. One end is extended to form a balancing bar for supporting the roll when the outer bearing is dropped to remove the formed shell. As shown in Fig. 1 the outer bearing has been dropped and the extended end is held against the half-bearing in a vertical standard provided for this purpose.

In Fig. 2 the construction of the outer bearing frame is shown. The screw-down mechanism is also indicated. A screw jack is connected to the bearing cap through a tension link. The jack is actuated by means of a worm and wheel, and a similar mechanism is employed at the drive-

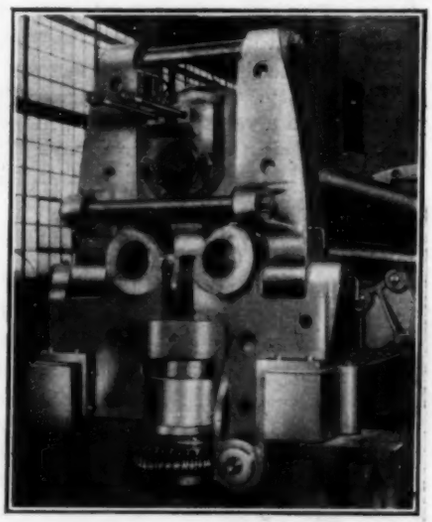


Fig. 2—Rear drop bearing-frame and screw-down mechanism

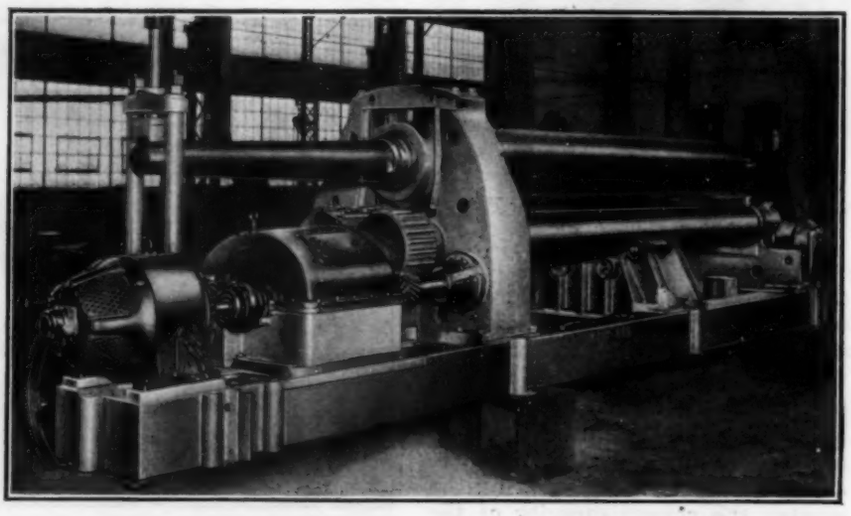


Fig. 1—Lake Erie Horizontal Plate-Bending Roll

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end bearing. A 35-hp. motor drives both worms by means of a single countershaft. As shown in the illustration, the drop bearing is designed for manipulation by means of an overhead crane, but a pneumatic or hydraulic cylinder can be furnished for power lowering and raising.

The main drive for the rolls is from a 75-hp. motor, coupled to an inclosed, herringbone reduction-gear unit running in oil. The two lower rolls are geared together by means of large spur pinions.

The machine is 33 ft. 6 in. in length, 7 ft. 2 in. in width, and 9 ft. 7½ in. in overall height. It weighs approximately 130,000 pounds.

Commerce "Micro-Poise" Balancing Machine

The Commerce Pattern Foundry & Machine Co., 2211 Grand River Ave., Detroit, Mich., is marketing the "Micro-Poise" balancing machine illustrated. This machine is particularly designed for balancing flywheels, pulleys, or other rotating parts with comparatively short axes.

Commerce "Micro-Poise" Balancing Machine

The standard machine will balance within a limit of ¼ oz.-in. running balance, and it can be furnished to a closer degree of accuracy with slight modification. It is claimed that this machine can balance and correct 20 to 25 automobile flywheels per hour.

The machine registers the angular location of the unbalance and is provided with a series of weights which show directly the amount of metal to be removed in order to correct the balance.

A motor-driven drill spindle is furnished to remove the excess stock.

American Vertical Gas-Carburizing Furnace

The vertical gas-carburizing furnace illustrated is being marketed by the American Gas Furnace Co., Elizabeth, N. J. The furnace is especially designed for carburizing large parts, such as gears, shafts, crankshafts, and the like that cannot be conveniently treated in the horizontal retort-type furnace.

The retort is cylindrical in shape and is made of a heat-resisting alloy. It is set in a vertical position in the heating chamber. The carburizing gas is admitted through the bottom of the retort and the air that it displaces initially and the excess and decarburized gas are allowed to escape through a valve in the cover. The retort extends up through the top of the furnace. The cover is equipped with an insulating spacing disk to minimize heat losses. The retort is fixed in position so that it should receive little abuse. It is guaranteed for 5,000 heat-hours of service.

Uniform heating of the retort is obtained by means of a large number of small gas burners arranged to fire tangentially into the annular combustion chamber between the retort and the furnace casing. These burners are spaced uniformly around the circumference and in equal tiers from the top to the bottom of the furnace. A fire clay lining of the combustion chamber is provided to prevent heat losses to the outer steel shell.

In operation, the retort cover is first removed by loosening the clamps, and the material to be carburized is placed inside. The cover is then replaced and the furnace is fired. An initial charge of carburizing gas is admitted to the retort in sufficient quantity to displace the air. Further admission of gas does not take place until a temperature suitable for carburizing is reached. A uniform flow of gas is then maintained. After one batch of material has been carburized, the second charge is placed in the retort immediately afterward in order to take advantage of the stored-up heat. It is claimed that the use of gas as a carburizing agent insures a uniform case, since the fresh gas reaches all parts of the work and no extraneous material is present to prevent penetration of the gas into the steel. Carburizing is said to proceed at a

American Vertical Gas-Carburizing Furnace

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rapid rate. Furthermore, it is not necessary to have an excessive amount of space between the parts being treated.

A small crane or air hoist should be used to remove the cover, to place the work in position, or to transfer the work from the retort to the quenching bath or the annealing pit. Simple fixtures can be used to hold the crankshaft and other odd-shaped pieces in position. The furnaces are made in various sizes, with retorts ranging from 15 to 30 in. in diameter. The depth of the retort is 30 in. in all sizes.

"Union" Portable Universal Saw

The "Union" portable universal saw, illustrated, is being marketed by Gallmeyer & Livingston Co., Grand Rapids, Michigan.

The table of the machine is mounted upon a cast-iron pedestal in place of the ordinary work bench. When the saw is being used the pedestal rests upon two rollers at the back and two stationary feet at the front. When the machine is to be moved a handle at the front is pulled

"Union" Portable Universal Saw

forward and by means of cam action the feet are raised from the floor and the weight of the machine is placed upon a third roller carried in a swivel bearing. In this position the machine is ready to be moved.

The motor and all the working parts are built into the upper portion of the machine so that it is a self-contained unit. This unit can be removed from the pedestal and used as a bench-type machine should occasion demand. Two types of motors can be supplied: a ½-hp. repulsion-induction type motor to operate from a lamp socket on single-phase alternating current, or a 1-hp. repulsion-induction type motor to operate from a power line. When equipped with this latter motor and an 8-in. diameter saw the machine will handle stock up to 12-in. in width by 2½-in. thick. In either case the motor is belted to the saw arbor, which rotates on ball bearings.

The table is a single casting measuring 25 x 26 in. It is fitted with a removable throat plate to permit the use of dado heads, cope heads, grooving saws, and the like. The saw can be raised from a position flush with the table to one 2½-in. above the table. The table can be tilted to any angle up to 45 deg. and can be locked at any desired setting.

Both cross-cut and ripping gages are provided on the table. The cross-cut gage can be used on either side of the saw. Two slots are planed in the table for this purpose. The gage can be set at any angle and clamped in position. Holes are provided in the gage for mounting an auxiliary wood face, where desired. The ripping gage is machined on both sides and can also be used on either side of the saw. The gage is provided with a T-head which, when clamped in position by means of a lever screw, lines up the gage with the saw.

A switch for starting and stopping the machine is placed on the front for convenience of the operator. The 8-in. saw is properly guarded and a splitter guard is also provided.

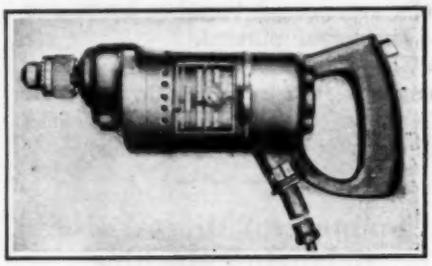
"Little Giant" Universal Electric Drill, No. 25-B

The Chicago Pneumatic Tool Co., 6 East 44th St., New York, N. Y., is marketing the No. 25-B "Little Giant" universal electric drill illustrated. The capacity of the machine is ¼ inch.

The handle of the tool is the pistol-grip type and is provided with a thumb-operated plunger switch. The cable enters at the base of the handle and is protected by means of a pliable rubber case.

The motor is of the universal type and will operate on both direct and alternating current. The motor has a simplified field structure with salient poles and only two coils. The field and armature coils are impregnated with an elastic baking varnish. The commutator is self-contained with its sleeves and heads and is made of rolled copper and amber mica.

Ball bearings are used throughout. The armature ball bearing at the



"Little Giant" Universal Electric Drill, No. 25-B

commutator end is supported in a bracket integral with the housing. The drill spindle is supported by ball bearings on each side of the spindle gear and in addition a ball thrust bearing is provided. The gears are made of chrome-nickel steel heat-treated to give proper hardness. The gears and bearings within the case are lubricated by grease. The switch, motor and gear housings are made of special alloy of high tensile strength. The design of the housing is such that the commutator and brushes may be inspected while the motor is running. The entire switch assembly can be removed from the drill for inspection and repairs.

The overall length of the tool is 12¾ in. and the net weight of the tool 6½ lb. The full-load speed of the unit is 1,280 r.p.m. Regular equipment includes 10 ft. of cable, a connector, and a three-jaw adjustable chuck for holding drills up to ¼ in. in diameter.

Leggott Circular Threading Tool

The circular threading tool illustrated is being marketed by F. J. Leggott, 20 Cleveland St., Battle Creek, Mich. The tool can be adapted for either internal or external threading.

A number of small flutes are

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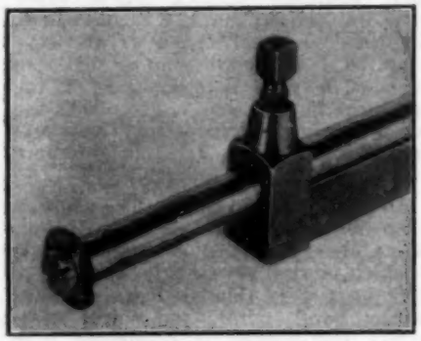
broached in the hole of the circular cutter and these engage corresponding grooves milled in the end of the round tool-carrying bar. The cutter is held in place by means of a flat-head screw that engages a tapped hole in the end of the bar. With this construction it is possible to



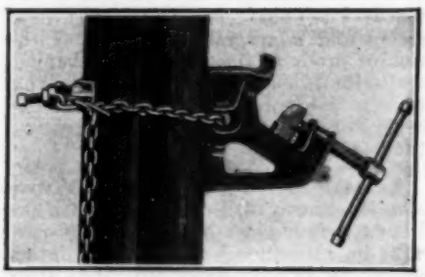
Leggott Circular Threading Tool

remove the cutter for regrinding without disturbing the setting of the bar on the tool slide.

The cutting point is placed on the centerline of the work or slightly below it, and in this position it is claimed that the cutter will not slip or hog into the work. The cutter is made from high-speed steel and is ground after hardening.

Oster Quick-Acting Post Vise

The Oster Manufacturing Co., Cleveland, Ohio, has developed a quick-acting post vise illustrated. The device is designed so that it grips and releases the pipe with one turn of the handle. The vise is of



Oster Quick-Acting Post Vise

the inclined side opening type. It is equipped with oil-tempered, tool-steel jaws, which, it is claimed, will grip the pipe securely without the danger of squeezing it out of round. The vise accommodates pipe sizes ranging from ⅛ to 2½ in. Short nipples can be handled since the jaws open wide enough to accommodate a 2-in. coupling.

A special chain and clamp is provided for fastening the vise to a post, when it is not possible to bolt it to a work bench. A special eye-bolt is also furnished for use in pipe bending.

Olsen Impact Testing Machine, 30-Meter-Kilogram Capacity

The Tinius Olsen Testing Machine Co., 500 North 12th Street, Philadelphia, Pa., is marketing the impact testing machine illustrated. The machine has a capacity of 30 meter-kilogram and is intended for making the Charpy test, wherein the steel specimen is in the form of a beam and is subjected to a hammer blow.

The hammer is in the form of a

Olsen Impact Testing Machine, 30 Meter-Kilogram Capacity

pendulum. It is raised by hand and released by a small latch. The work required to break the specimen over the support is indicated directly on a dial.

The machine can also be arranged to make a small impact tension test, in which case the specimen is placed at the back end of the raised pendulum weight.

Tomkins-Johnson Universal Work Stand

The Tomkins-Johnson Co., Jackson, Mich., has developed the universal work stand illustrated. It is particularly designed for holding die-blocks, but may be adapted for other uses by means of special attachments.

The die-block is held on the stand by means of a vise. The stand is adjustable for height and direction so that the die sinker can turn the die-block in any position while he works upon it. The stand is fastened to the floor by means of cap screws.

Tomkins-Johnson Universal Work Stand

A ball and socket joint is used to obtain the directional feature.

The work stand can be used without the vise by putting on special attachments. Automobile parts such as fenders, doors, and radiators and the like can be held in any position for finishing.

Harrington Electric Hoist, 1-Ton

The 1-ton electric hoist, illustrated, is being marketed by the Harrington Co., Philadelphia, Pa. The hoist is designed for hook suspension, either parallel or at right angles to the body, for use with an I-beam trolley. The minimum distance between the

Shop Equipment News

suspension hook and the load carrying hook is 23½ in. Fixed lug suspension can also be furnished.

The hoist is driven by means of a universal motor, rated at 2½ hp., that operates on either a.c. or d.c. of any frequency from 0 to 60 cycles. The motor is arranged for operation at either 110 or 220 volts, single-phase if alternating current. It is series wound and has high starting torque. The motor is covered to prevent the entrance of water from above, but it is ventilated by means of louvres. A fan is mounted on the armature shaft to insure a circulation of air

Harrington Electric Hoist, 1-Ton

around the windings. A brake is incorporated on the shaft for stopping the motor quickly. It operates automatically and can be adjusted from the outside. The armature shaft is mounted upon ball bearings. The wiring to the motor is inclosed in a metal conduit.

The hoist drum is driven through two spur-gear reductions and a final worm-and-wheel reduction unit. The gears are made of heat-treated alloy steel, while the wormwheel is of bronze. The worm is mounted upon ball bearings, both radial and thrust. A circulating system is used to lubricate the gears and bearings. The worm operates submerged. A light grease is poured into the main frame through one filler hole and is automatically distributed to all bearings and gears. The worm and wheel are self-locking so that the load cannot overhaul the motor through the gears.

The hoist is controlled by means of a drum controller. Two rope-pull handles are provided to operate the controller through a system of rack and pinion gearing. The pull handles are so shaped as to indicate plainly the direction of the hook movement. Remote push-button control can also be supplied.

Due to the series-wound motor the speed of hoisting ranges from 10 ft. per min. under full load to 25 ft. per min. light. The load is carried on a flexible steel chain, and the hook at the lower end revolves on a ball thrust bearing. Stop limits on the chain prevent over travel in either direction. Any desired length of chain can be supplied.

The hoist measures 28⅞ in. overall and is 13¼ in. wide. It weighs 210 lb. net.

Trade Catalogs

Blowers, Electric, Type "FB." The Buffalo Forge Co., Buffalo, N. Y., has published a four-page pamphlet on its type "FB" variable and constant-speed electric blowers. In this type of blower the driving motor is mounted upon a unit base with the fan casing. The fans are described and illustrated, and engineering data on their operating characteristics are given.

Brass and Bronze Castings. William H. Barr, Inc., Buffalo, N. Y., has published a small loose-leaf booklet containing useful data concerning brass and bronze castings. The physical and chemical properties of eleven alloys are given. The chief characteristics of the alloys are pointed out, and in some cases microphotographs are used. Other useful tables are given, including a condensed table of physical constants of the principal alloy-forming elements.

Dividing Tables, Universal, for Jig Boring Machines. The R. Y. Ferner Co., Investment Bldg., Washington, D. C., is distributing a four-page pamphlet on the universal dividing tables for jig boring machines made by the Société Genevoise D'Instruments De Physique of Geneva, Switzerland. The construction of the tables is indicated by means of drawings and photographs, supplemented by the text. Some examples of the uses of the table are also given.

Drill Chucks. The Jacobs Manufacturing Co., Hartford, Conn., has issued a publication entitled "The Spindle Book." The booklet contains ninety-six 5½x8½-in. pages. In it the spindle specifications for all makes and sizes of spindle machines manufactured in the United States are given. The tools are grouped into ten major divisions: portable tools; electric, pneumatic, and flexible-shafts tools; bench grinders and motors; tapping machines with attachments; lathes, screw machines and centering machines; woodworking machinery; valve re-facing machines; drill and tap grinders and other special purpose tools. Under these heads the tools are grouped by manufacturers' names. The specifications for each machine state whether the spindle is regularly equipped with a Morse taper shank, a straight shank, a Jacobs chuck, or other make of chuck as the case may be. At the beginning of each division a general discussion of the machines in the group is given with the aid of typical photographs. This booklet should make a valuable reference work.

Drives, Right-Angle. The Boston Gear Works Sales Co., Norfolk Downs, Mass., has published a small 36-page booklet on its right-angle drives. In this booklet is tabulated standardized worm, bevel, miter, and spiral gear-sets. The booklet is illustrated with photographs and line drawings.

Grinding and Polishing of Metals, Flexible. Norton Co., Worcester, Mass., issued a small booklet on flexible grinding and polishing. Useful information about the various types of wheels, and belts, about the proper use of glue, and a general discussion of abrasive grain is given. The booklet is well illustrated by means of photographs. It is entirely technical in its treatment.

Grinding Machines, Universal. The Norton Co., Worcester, Mass., has issued a bulletin on its type L multipurpose grinding machine. The chief characteristics of this machine are pointed out, and important specifications are given. Several illustrations are used to show typical examples of work done on this type of machine.

Hardness Testing of Metals. The Wilson-Maeulen Co., Inc., 383 Concord Ave., New York, N. Y., has published a compendium of the possibilities and current practices with its Rockwell type of hardness tester. The subject is divided into surfaces, skill, accuracy, range and adaptability, speed, inspection of product, specifications in buying and selling, and testing in general. The text is presented in the form of excerpts of letters from various users of the machine.

Lathes, Turret. The Jones & Lamson Machine Co., Springfield, Vt., has issued a four-page bulletin on its new 4x34-in. Hartness flat turret lathe, which is briefly described and illustrated. A time-study sheet of a typical bar job is also given.

Metallographic Equipment. Bausch & Lomb Optical Co., Rochester, N. Y., has published a 22-page booklet on its model GB-ILSAA metallographic equipment. A brief technical description of the outfit is given and numerous photographs of the outfit and its various parts are used to supplement the text.

News of the Week

Machine Tool Builders' Association to Have Own Show

To be held in Cleveland, in September, 1927

Announcement has just been made of the first National Machine Tool Builders' Exposition. It is to be held in Public Hall, Cleveland, Ohio, September 19 to 24, inclusive, 1927. The exposition will be under the auspices of the National Machine Tool Builders' Association, and according to the announcement is to be "held in the interest of sound distribution economics and for the convenience of the machine tool using industries."

The announcement issued by the association follows:

"The National Machine Tool Builders' Association—Makers of the Master Tools of Industry—in 1927 inaugurates its own exposition for the showing of these master tools to industry.

"It has become obvious to builders of machine tools that there must be centralization and simplification of their exposition effort and outlay. The machine tool industry is among those to whom an actual exposition of products is necessary for effective distribution. Heretofore, however, the industry as an industry has not applied constructive effort to the exposition of its own products. There has been no coherent, effective presentation of their products, to identifiable users, by the machine tool makers as an industry.

REGULAR EXPOSITIONS NECESSARY

"As a result machine tools are displayed and demonstrated to sundry sections of the industrial public, and even to sections of the general public, in various and numerous regularly or intermittently scheduled expositions. In these expositions they are grouped either with miscellaneous industrial equipment or with displays primarily of a specialized technological character not always directly related to machine tool technique or utilization.

"This situation and this need now lead the National Machine Tool Builders' Association, after careful investigation and preparation, to announce for 1927 the first of the industry's own shows.

"The primary purposes of the exposition are the elimination of waste involved in the scattering of exposition energy and expense—the providing for 1927 and succeeding years of the industry's own agency geared to a clear-cut business purpose—the making more effective, while less dispersed and less costly, of the necessary annual visual presentation of machine tool progress and possibilities to machine tool buyers actual and potential. It is not to be simply "another show" in which machine tools may be displayed. It is to be a centralized, single-goaled, sound and necessary medium for the industry's joint and necessary distributive effort.

"A basic feature of the exposition will be the exclusion of the general public—of all persons not having a reasonably direct interest in machine tools and their accessories.

"Admission will be by registration only. There will be no ticket distribution, no entrance fee, no crowds of mere sightseers. By commercial, industrial or technical registration-identification only an interested person may obtain admission. He will wear a badge identifying him by name and by company or other affiliation, to the exhibitor.

TO PROMOTE MACHINE INSPECTION

"Therefore, the exposition will be a concentrating, for the serious purpose of inspection and buying, of machine tool users.

"Plans are already under way for stimulation of this selective attendance. A substantial number of machine tool buyers and users are desirous of an opportunity to examine, without distraction, a comprehensive display of the latest, most effective in design, and most highly productive, tools and accessories. Such people will attend upon mere announcement of this exposition. Increase of this assured, influential nucleus will be sought by the association, but the attendance will be confined to those with direct interest in machine tools.

"The exposition will not be a quantity-attendance show. It will be a buyer's, a user's, a specifier's, an honest investigator's show. Aisles will not be filled with idly curious visitors; booth attendants will have opportunity to talk at length with prospects.

"A carefully laid out and aggressive publicity program is already formulated, embodying the use of magazines, direct-mail literature and other approved media and methods. The Association can give promise now, that this program will assure to exhibitors this select quality-attendance in numbers widely representative of the continent's machine tool users.

"Primarily the exposition will be a business-hours show. Adequate and convenient accessory services will be available at rates regulated by the management. Frequent lists of registrants will be distributed to booths daily. Every convenience of a modern, well-conducted industrial exposition will be at the disposal of exhibitors and visitors. Rental rates will favorably compare with those of other important industrial shows.

"An experienced exposition manager is in immediate direction.

"Allotments of space in the exposition will be made by the association to member companies as a first and distinct group, and to non-member companies as a subsequent group. Allotment will be made in accordance with an impartial and impersonal system eliminating favoritism within either group. First allotments will be made, under this method, to member companies of the association, at the association's October convention, 1926.

"The exposition is open to displays, by any reputable company or individual, manufacturing machine tools, or machinery, equipment, supplies, accessories, materials, services, or other articles, methods or processes essential or incidental to the industrial utilization of modern machine tools.

"The exposition is under the control of an association committee comprised of: J. Wallace Carrel, vice-president of the Lodge & Shipley Machine Tool Co., chairman; P. E. Bliss, vice-president of the Warner & Swasey Co.; O. B. Iles, president of the International Machine Tool Co.; H. W. Dunbar, assistant general sales manager of the Norton Co.; and E. J. Kearney, secretary of the Kearney & Trecker Corporation. The manager is Roberts Everett, 1328 Broadway, New York, N. Y."

The success and representative scope of the exposition already are assured, according to the association, by the number of machine tool building companies which have, prior to its first general announcement, specified the amounts of display area each will require. The association's prospectus lists more than fifty of these companies.

German Machinery Trade in South America

The German machinery export trade to South America has bettered substantially in the last year, according to the latest Berlin advices, and present prospects for the sale of machine tools are claimed to be better than at any time since before the war. Together with the increasing sales, working conditions in the German machine shops are said to have improved. Chile and Argentina are the two principal markets in South America for German machine tools, and the export of this class of machinery to the two countries reached 35,985 tons for the year 1925 as compared with 25,410 tons during the previous year. The increase indicates the rebirth of German exporting.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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THAT a magazine article by Professor William Z. Ripley of Harvard should have checked the advance in the stock market and reversed its trend shows how largely psychological the recent boom has been.

Inasmuch as Professor Ripley is a publicist whose views carry much weight, it was quite natural that the public should heed his advice to "stop, look and listen." The reactionary tendency of the stock market reflects the consideration his article received, and some accountants will have to work nights if the Federal Trade Commission takes his hint and demands that all industrial corporations shall publish statements similar to those required of the railroads. Of course, it remains to be seen whether the hint will be taken, but the fear that it may is likely to be a restraining influence, at least until Congress meets.

For this reason speculators are now more inclined to sell stocks than to buy them. Among those who keep an ear particularly close to the ground, a growing expectation is evident that the autumn will not be a particularly happy one for so-called "big business." It is said that much anti-trust agitation is being worked up in the Washington lobbies and that the Administration is sensible of it is shown by the defense of its record in "trust-busting" that recently emanated from the summer White House. Of course the agitation may produce nothing but Congressional oratory, but even that may help depress a stock market that is nervously balanced and susceptible to headlines as well as to the actual course of autumn business.

But fundamentally there is nothing wrong with business. The change that has occurred is chiefly sentimental and if trade and industry continue active, the speculative markets will soon be on an even keel again.

Some unemployment is implied in the continued contraction of building operations and the demand for structural steel is a little disappointing. But these are the only concrete indications of a recession that are discernible and merchants look forward confidently to the approaching autumn.

The automobile industry is working out of its usual summer recession and the authorities say a high rate of output is assured during the early fall months; and the steel trade reviews report that with the exception noted the demand for material is unrelaxed and that production and prices both are fully maintained.

Cotton goods are higher, with denims and ginghams in unusual demand. The advance in the cotton market is, of course, reflected in the prices asked but most manufacturers are still confident of a big crop and are reluctant buyers of the raw material they require. Among cotton speculators this short interest is regarded as strengthening.

What's Doing in Industry

A slight upward trend in business among machinery and machine tool builders and dealers is still shown by reports from various centers this week. In New England the automotive industry has placed an increased number of orders and plants throughout the territory are working on full-time schedules with the maximum working forces. New York is a little slower in recuperating from the summer conditions but there has been a small increase in railroad activity. Industrial activity remains firm.

The Buffalo market is holding up well. The increase in activity has been somewhat postponed through a quantity of used machinery that has been released on the market. Philadelphia has received some large railroad orders and a steady volume of business seems to be maintained.

Conditions in the West are better than those in the East. A fair number of inquiries from railroads has been received in Chicago and these will soon balance the falling off in business during August. Cincinnati has been less favored than some of the other centers but the number of inquiries has brought hopes for the immediate future. Detroit shows a steady increase in the number of inquiries over the past two months. Milwaukee and Cleveland report that conditions are very good and that some automotive activity is apparent.

An economic renaissance throughout the world is indicated, provided America does not lose its head and go *too fast*.

In the grain markets, the peak load of the wheat crop appears to have passed and it must be admitted that the prices realized have averaged above expectations. As 85 per cent of the corn produced is fed to live stock or otherwise consumed where it is grown, the open market quotation is no longer of much importance, but there are many who expect higher prices because they believe that the crop is short.

Sugar improved on the liquidation of the September position and higher prices are generally looked for. Early estimates of the European beet sugar crop are 5 per cent under last year's production. The coffee market is easier and seems to be reflecting some dissension among the Brazilian friends of coffee. Rubber is sustained by the certainty that exports will be curtailed if the price declines. It hangs around 40 cents, which seems fair to both producer and consumer.

Silk and wool have been steady and the fabrics into which they are manufactured show but little change.

Distributive trade has been good for August, but the shadow of the Labor Day holiday is already discernible and it will be September 15 before everyone is in harness again. It is expected that business will be very active by that time and there will be keen disappointment if that expectation is not realized. The possibility that we have overdiscounted the future and the probability of higher interest rates are, in fact, about the only contingencies that suggest caution.

The latest reports show that brokers' loans are still increasing and demand for commercial funds is also a little more active; the total of commercial loans made by the reporting member banks of the Federal Reserve System is, in fact, $350,000,000 larger than a year ago. But there has been very little increase in borrowings from the Reserve Banks and their combined reserve ratio is still above 75 per cent.

The foreign news is also encouraging. The Church and the Government seem to be getting nearer together in Mexico and the end of the British coal strike seems nearer because the Nottingham miners have deserted the union and gone back to work. Reports from East India continue to emphasize the prosperity there, and with the approach of autumn an economic renaissance throughout the world is indicated, provided America does not lose its head and go *too fast*.

The Industrial Review

Progress of the machinery and machine tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

New York

No radical change has taken place in the New York market this week. There was little increase in buying and a small increase in the number of inquiries. No great increase is looked for until well into September when the volume should considerably excel the fall records of last year. It is not generally believed that activity in New York will reach that of the first six months of this year.

Dealers have reported that there is enough business to make the month a fair one but that the business must be more sought out than previously. Among the machines sold during the week were an axle lathe, a 500-ton wheel press, a 90-in. journal-turning lathe, a 26-in. by 14-ft. lathe, one geared-head lathe, three automatic lathes, one screw machine, two jig-boring machines, eight upright drills, two radial drills, two automatic milling machines, a shaper, a vertical surface grinder, two centerless grinders, a nut-tapping machine, a power brake, and a gate shear.

The number of railroad orders and inquiries increased somewhat, but most of the orders come from general industrial plants. A number of large orders are expected to be closed early this month.

Chicago

The last half of August has shown considerable falling off in the volume of machine tool business transacted as compared with the first half of the month. Notwithstanding this decline, dealers are not disposed to complain, the fact that the month's business as a whole will make a better showing than had been expected being referred to with a degree of satisfaction. In some lines, particularly heavy machinery, a number of worth while sales have been recorded during August, the groundwork for which, however, had in most cases been laid earlier in the year.

There still is an intermittent inquiry for standard tools from railroad sources, the Northwestern being the principal factor in this respect. The new list from the Rock Island, expected for some weeks past, is still being awaited, and is due now at any time. The Chicago Board of Education is making inquiry for a number of smaller tools for the Hirsch, Jr. Manual Training School. Woodworking machinery is in fair demand, with the probability that this will increase with the coming of fall. Prices in general are being well maintained for both new and used machinery equipment.

Cincinnati

Although the past week was a somewhat dull one in the Cincinnati machine tool trade, with the entry of September the manufacturers and selling agents see many encouraging features, and a general air of cheerfulness prevails. The common feeling is that the trend of all lines of business is upward, and as a consequence the demand for machine tools is about to increase.

The feature of the week was the demand from concerns in the automotive industry. The orders were not large, most of them being confined to single tools, but there are strong indications that good-sized lists are about to be purchased by makers of automobiles, trucks, buses and accessories. The demand from this market, it is pointed out, is largely for specially-adapted machines, of greater efficiency than the ordinary, requiring only a slight modification of standard design in many cases, and makers who are in position to furnish these are getting a great many preliminary orders, for experimental purposes.

Railroads did very little buying in the past week, but several lists were received from this source. The bulk of the week's bookings consisted of orders from all sections of the country, from diversified users, calling for single tools and replacements. A large number of inquiries were received, these being well distributed over the country and well diversified as to types and sizes of tools.

Production was maintained at the usual level during the week, and no reduction of output is expected. Manufacturing conditions continue to be favorable in every respect, but there is no surplus of skilled labor.

Buffalo

While there is no denying the fact that the vacation season has had a quieting effect upon business here, it is generally believed that business in the machine tool and allied trades is holding up well considering the season of the year.

Some machine tool dealers report August better than July and some stated that incoming inquiries during the vacation weeks indicate that the last half of the year will be fully as good and probably better than the first half. Several deals are being held off pending the return of key men from vacations.

One of the most encouraging reports came from a company which reported a good group of single machine orders coming from a wide variety of industries. It was stated here that the trend seems to be toward large machines rather than small.

The demand for electrical equipment still continues to hold an important place in the business here ranking up to and sometimes higher than the regular machine tool trade in activity. One irritating factor has been the dumping of some used machinery upon the market.

Detroit

Although the number of inquiries received by machinery dealers continues to show a steady increase over the past two months, actual sales of machinery and machine tools in Detroit and surrounding automotive centers are remaining nearly stationary.

Most motor car plants appear to be well tooled and, with the exception of one or two big jobs, Detroit manufacturers are merely attempting to keep their equipment in its present shape.

An order for the equipment of three additional boilers at its River Rouge plant has been placed by the Ford Motor Co. With complete water walls and air heaters; this order amounts to more than $500,000.

A crankshaft honing machine has been installed at the Packard plant. This company has also installed a special machine with diamond cutters to bore the babbitt connecting-rod bearings.

Cylinder-finishing equipment has been installed at the Paige plant. At the Chevrolet plant in Flint, Mich., equipment has been installed to round the cams on the redesigned camshaft.

New England

An improvement in the business volume for the automotive industry appears in the New England territory. Manufacturers of special parts and machinist contractors in general state that this class of trade is favorable and the prospective business is bright. The slight dip in the curve appears to be past. Manufacturers of machinery for production for the automotive industry also report increase in sales and excellent inquiry mail.

The ball bearing industry is especially active and plants throughout the territory engaged in this production are working on full-time schedules with maximum working forces. The number of employees is being increased in New Britain and Bristol plants.

Builders of small tools report a growing volume of business, indicating to them that the temporary depression in this trade is over. Production of hand tools is going ahead without any indication of let-up.

Cleveland

The steady upward trend of machine tool business, which had its inception during the closing days of July, is being maintained during August and the latter month bids fair to equal and in some instances to surpass any month of the year in the volume of sales. No large lists were booked for the past two weeks but a satisfactory number of orders for single pieces were received. The entry of buying by the automobile industry for the past fortnight has given added impetus to the buoyant market.

Inquiries are on the increase and with orders about to be closed and in prospect, it is the opinion of the trade that the sales curve will go up in the next thirty days.

Export business is showing some activity. An automobile manufacturer from England has an inquiry out for forty tools. Several open side planers have been sold and a list of tools wanted has been issued by one of the truck manufacturers.

Philadelphia

Machinery and machine tool business in Philadelphia remained on an even keel during the last fortnight. Favorable indications prevailed, although lacking in signs tending toward boom conditions or a record breaking volume.

Some of the larger manufacturers reported substantial orders from the recent purchase lists of the Illinois Central Railroad Co., and the Atlantic Coast Line, with other industries placing some orders and making inquiries.

The volume continues somewhat ahead of what it was at this time last year. One of the city's largest manufacturers announced its plant is operating at about sixty per cent of its full capacity, with indications that that ratio will continue well into the Fall.

The call for tools for locomotive repairing continued spotty and uncertain as to the future. Firms engaged exclusively in this line report that business is somewhat ahead of this period last year.

Milwaukee

Expectations concerning the volume of business afforded local manufacturers of metal-working equipment during August were fully met, and the trade enters September well fortified with orders and maintaining a rate of output comparable with the highest of the present year. Midsummer business has been exceptionally favorable and the movement of equipment has been of a most gratifying nature to manufacturers as well as dealers.

Prospects for railroad business have brightened perceptibly by the permission granted the receivers of the Chicago, Milwaukee & St. Paul to spend approximately $100,000 in retooling the car construction, and locomotive and car repair shops at Milwaukee. This is the largest railroad shop in Milwaukee, and one of the largest of the Chicago, Milwaukee & St. Paul lines. Beyond making the most necessary replacements, the Milwaukee shops have not favored the machine tool market in a long time, due to the receivership and events preceding the bankruptcy proceedings.

Milling machine manufacturers are working on a fair volume from the automobile trade, which is not buying as a general rule, but furnishing a relatively excellent volume by purchases on the part of several of the largest groups.

Aeronautic Meeting and Banquet Held in Philadelphia September 2 and 3

Under the auspices of the Society of Automotive Engineers an aeronautic meeting has been held at the Bellevue-Stratford Hotel, Philadelphia, September 2 and 3, 1926. At the opening technical session held on the morning of September 2, Com. E. E. Wilson, G. J. Wilson of the Pratt & Whitney Aircraft Co., and E. T. Jones of the Wright Aeronautical Corporation covered many angles in the development of air-cooled engines for aircraft.

Lieut. Com. C. E. Rosendahl, commander of the Los Angeles, opened the afternoon session with a paper entitled "Development of Methods for Mooring and Handling Rigid Airships." This presentation was followed by short papers on airplanes for individual ownership by E. A. Stinson of the Stinson Sales Corporation, and L. G. Meister of the Buhl-Verville Aircraft Co. and others. The concluding paper of the session was by Dr. Adolf Rohrbach of the Rohrbach Metall-Flugzeugbau and dealt with economical and rapid production of all-metal airplanes and seaplanes.

W. B. Stout, chairman of the Aeronautic Meeting Committee opened the air transport session with introductory remarks on the need for utilizing satisfactory equipment and methods for the successful operation of aircraft. W. L. Smith of the Air Mail Service prepared a paper entitled "How I Fly at Night." The illumination of air routes was discussed by C. T. Ludington of the B. B. T. Corporation of America, and H. C. Ritchie of the General Electric Co. The subject of directional radio in flying was discussed by Capt. W. H. Murphy of the Army Air Service.

The National Aircraft Factory was visited by the members of the society who studied examples of the newest aircraft types and watched the test of engines on the dynamometer stands. The speakers at the banquet of the society were Senator Bingham and Assistant Secretaries Warner, Davison and MacCracken.

Thirteenth Annual National Business Conference at Babson Park, Sept. 11-19

The thirteenth annual National Business Conference will be held at Babson Park, Mass., September 11 to 19, 1926. The subjects for discussion include general business, sales policies, commodity prices, the building situation, labor and wages, investments, installment selling, foreign conditions, motor and air transportation developments, weather and its effect on business, and the present Florida outlook. These subjects will be the basis for round-table discussion.

Mr. Babson will be the principle speaker at the first session, and at this time he will make his annual forecast on the business situation for the coming year. On September 13, Grace W. Ripley will discuss the use of color in selling. On other occasions Joseph M. Young, of Hollywood, Florida, will speak on the outlook for Florida; Edwin C. Vogel, vice-president of the Commercial Investment Trust, New York, N. Y., and Samuel H. Mansfield of the Old Colony Mercantile Agency, will lead the discussion on installment selling trends in the automobile and other industries. Noted authorities have been selected to discuss the effect of weather on business.

A.S.S.T. to Honor Gary and Schwab at Annual Banquet

Elbert H. Gary and Charles M. Schwab are to receive certificates of their election to Honorary Membership in the American Society for Steel Treating, at the annual banquet of the Society to be held at the Drake Hotel, Chicago, Thursday evening, September 23. On the same evening the Henry Marion Howe medal established in honor of the late Henry Marion Howe, will be awarded to the author of the best paper published in the Society's Transactions during the past year.

Founder Membership will be awarded to Arthur G. Henry, of Chicago, at the banquet. Mr. Henry was one of the originators of the society and is known as the father of the exposition. It was at his instigation and under his management that the first exposition was held in Chicago in 1919.

Standardization in Aeronautics

The third annual Army-Navy conference on standardization or simplification in aeronautics will be held during the week of September 13, 1926 at the Bureau of Aeronautics, Navy Department, Washington, D. C. The conferences have been held in order to promote standardization in the manufacture of aircraft.

The expansion of subject matter considered apt for standardization has been in keeping with the results so far attained, so that the list of subjects to be discussed is the most comprehensive that has ever been undertaken in the industry, and, perhaps, in any of the industries.

The subjects for discussion at this conference are listed below:

Standards:

Upset head vs. machine head bolts, steel turnbuckle barrels, cowl fasteners, wheels and tires, strength of standard lugs, drilled size for tapped holes, adjustable fork ends for struts, class 3 medium weight for threads, engine contral units, fuel system fittings, hose clamps, primers, hand fuel pumps, fork end terminals for engine controls, ball joints for engine controls, spark plug terminals, Radiator shutter control lever, engine bearer spacing, radial engine mountings, shock absorbing devices, tail skid shoes, stitch spacing for sewing fabric to wing ribs.

Specifications:

Bend tests for streamline tie rods, spring wire (round) steel, flat spring steel, radiator hose Spec. N.A.F. H-3a, the use of cadmium plating, tubing—3S—aluminum alloy, inspection for aircraft materials, Spec. N.A.F. G-1b, aluminum alloys for intricate forms such as manifold, etc., heat-treatments for high-strength material such as engine parts, etc., high-tension ignition cable, fineness of aluminum powder for use as a pigment, protective coatings (Metal and Wood):

(a) Electrogalvanizing, (b) sherardizing, (c) cadmium plating, (d) chrominum plating, (e) bituminous solutions (f) enamels, (g) varnishes (Spec. Navy 52V12a) (h) dope proof paint (Spec. Navy 49P2); dopes, cellulose nitrate and acetate (Navy Spec. 49D3 and 49D4), silk fabric for parachutes, tubing, test specimens—flat vs. full section tensile.

Foreign Demand for American Tractors Increasing

Exports of tractors from the United States have shown rapid and consistent increases during the past five years until at present they constitute about one-third of the total agricultural implements exports, according to the Department of Commerce.

Foreign shipments of tractors were abnormally large in 1918, 1919, and 1920, as a result of the post-war boom. The immediate effect of this boom was disastrous, however, and resulted in a serious curtailment of tractor exports in 1921. This was followed by a relatively large increase in 1922, and has been followed by a large increase in every succeeding year.

The largest purchaser of tractors during the first half of 1926 was Russia. The second largest purchaser of tractors during this period was Canada. Italy and France occupied, respectively, the third and fourth positions. Australia and Argentina, ranking fifth and sixth, both show some decrease in the number purchased.

Power Show to Open December 6 at New York

The National Exposition of Power and Mechanical Engineering will be held during the week beginning December 6, 1926. The exposition will occupy four floors of the Grand Central Palace, in New York. Over 450 manufacturing firms will be represented in the exhibition of equipment. Ten leading manufacturers will display welding apparatus. Power transmission equipment will be one of the features of the show and this section of the exposition, it is said, will be the most complete showing of apparatus of its kind in the country.

P. R. T. Operates Air Line to Washington

The Philadelphia Rapid Transit is now operating an air line between Philadelphia and Washington. Two Fokker passenger planes are now in operation and a third is to be placed in service in the near future.

Both planes, built by the Fokker Aircraft Corporation, are equipped with Wright Whirlwind air-cooled motors.

Obituaries

CLAUDE E. CHARD, for several years Cleveland district manager of the Austin Co., engineering contractor, died suddenly on Aug. 13.

EVERETT R. BISHOP, who died recently in New Haven, Conn., was one of the founders of the Kilborn & Bishop Co., New Haven, Conn. He was for a time the city clerk of New Britain, Conn.

JAMES V. HAMILTON, retired inventor and builder of much of the sugar machinery now used in Cuba, died recently at Half Arce, N. J. Mr. Hamilton would have been seventy on Aug. 29. He was a member of the American Society of Mechanical Engineers. A wife, a son and a daughter survive him.

Business Items

The Marshall & Huschart Machinery Co. is now located in its new quarters at 571 West Washington Boulevard, Chicago, Ill.

The Lester Machinery and Supply Co., Indianapolis, Ind., has established headquarters at 1116 East Georgia St., of that city.

Holcroft & Co., Detroit, manufacturers of heat-treating furnaces, have opened a branch office at 802 Putnam Building, 10 North Clark St., Chicago, Ill.

The Cogsdill Manufacturing Co., of Detroit, announces plans for the construction of an additional factory for the manufacture of metal cutting tools.

The L. A. Young Industries, Inc., 9209 Russell St., Detroit, Mich., manufacturer of automobile equipment, has plans for a new one-story power plant at its factory to cost close to $125,000 with equipment. L. A. Young is president.

The Devon Metal Goods Co., Milford, Conn., has been incorporated to manufacture metal novelties. The incorporators are Walter D. Groat, Anton C. Raffauf and J. P. Koskuba.

The Webster Manufacturing Co., Tiffin, Ohio, has purchased the Chicago mills of the Weller Manufacturing Co. The latter has been engaged in the building of hoisting machinery.

The Campbell Wire Specialty Works, South Bend, Ind., will move its plant to Crawfordsville, Ind. The company will occupy the buildings formerly used by the H. and D. Shock Absorber Co

The New Castle Foundry of the Stove & Range Co., Pittsburgh, Pa., which has been closed since April, will resume operation. The resumption will take place as soon as sufficient men are obtained.

The Kirk & Blum Manufacturing Co., of Cincinnati, manufacturer of pneumatic engines and machinery, has purchased a factory building adjoining its present plant and will expand its manufacturing facilities.

The Stetson Textile Machine Corporation, Norwalk, Conn., has been organized to manufacture and repair machinery of all kinds. Thomas R. Stetson, Tower F. Hamilton, and Thomas E. Heatly are the incorporators.

The Indianapolis Belting & Supply Co., 34 South Capital St., Indianapolis, Ind., has been appointed as district representative, in Indianapolis and vicinity, for the products of the Foote Bros. Gear & Machine Co., Chicago, Ill.

The Goodman & Wolfe Co., Terre Haute, Ind., has purchased the machinery, equipment and service of the Lexington Motor Car Co. All but the service department will be resold. The service department will be maintained for the supply of repair parts for cars previously sold.

The American Sheet and Tin Plate Mill, Scottdale, Pa., is to be electrified. Three old engines will be replaced and others will be electrically driven. The wooden building for sheet bar storage will be replaced with an all steel structure 78x325 feet.

The Gemmer Manufacturing Co., Detroit, Mich., manufacturer of automobile hardware, has purchased the Detroit plant of the Parish Manufacturing Co., Cleveland, Ohio. The property consists of 11 acres of land and upon it are buildings having 95,000 sq.ft. of space. Considerable remodeling will be done and new equipment will be installed.

The Sundstrand Machine Tool Co., of Rockford, Ill., announces the appointment of T. B. Buell, formerly of the New Process Gear Co., as sales engineer in the Eastern territory with headquarters at Syracuse. L. A. Dumser, formerly with the Kearney & Trecker Corporation, has been appointed sales engineer in the Middle-West territory with headquarters at Milwaukee.

The Arter Grinding Machine Co. has moved into new quarters at Sagamore Road, Worcester, Mass. The new building is a one story brick and steel building, 90x100 ft. A monitor roof covers the central bay which is thirty feet wide and extends the length of the shop. A 5-ton traveling crane is being installed in this bay. The two side bays will be used for the machinery manufacturing operations and the center one for erecting.

Personals

M. G. DUNBAR, sales representative of the Landis Tool Co., in New York and New England has resigned.

J. R. TROTT has been appointed sales manager of the Abbott Ball Co., of Hartford, Conn., manufacturer of bearing balls.

CHARLES H. ALVORD has resigned as president of the Hendey Machine Co., Torrington, Conn. He has held the office since 1919.

W. S. JONES has been elected vice-president of the Carpenter Steel Co., of Reading, Pa. He will be in charge of tool steel sales.

WALTER GILMER has resigned as chief of engineering of the L. H. Gilmer Co., Detroit, Mich. He will remain a director of the Company.

J. N. JOYCE has joined the Cleveland office of the Bridgeport Brass Co., 2017 Superior Viaduct, Cleveland, Ohio, for the purpose of soliciting sales or Bridgeport valve and Plumrite pipe.

VERNER J. SWANSON, of Miles City, Mont., has been appointed consulting engineer for the Enginepower Research Corporation, of Cleveland. Stephen E. Donohoui has been appointed chief engineer of the same organization.

F. R. BENSON, according to an announcement, is to retire from the Terre Haute Malleable & Manufacturing Co., Terre Haute, Ind. He is disposing of his interest to a group of Milwaukee men headed by L. M. Eyke.

PAUL MOORE has been named head of the production department of the Garford Truck plant at Lima, Ohio. He was formerly president of the Service Motors, Inc., of Wabash, and a member of the Wabash Chamber of Commerce.

SPENCER B. GREENE has been appointed Trade Commissioner of the Department of Commerce at Santiago, Chile. Previous to his appointment he has represented American business houses in several Spanish-American countries as well as in Spain and Italy.

FRED W. AYRES has been made works manager of the Oakland Motor Car Co., Pontiac, Mich. He was formerly plant analyst for the Oakland plant and previously was vice-president in charge of engineering of the Klaxon Division of the General Motors Corporation.

JOSEPH H. EHLERS has been appointed as engineering trade commissioner of the Department of Commerce at Tokyo, Japan. He has been engaged in oriental affairs for some time and previously was a member of the faculty of the Pei Young University at Tientsin, China.

WILLIAM L. BATT, president of the SKF Industries, Inc., New York, N. Y., has been decorated by the King of Sweden with the Knighthood of the Order of Vasa, First Class. Another American business man knighted at the same time, was George F. Berkander of Providence, R. I.

RALPH L. SHAW has been appointed Milwaukee district manager for the W. A. Jones Foundry and Machine Co., of Chicago, to succeed Fred E. Holtz, who resigned. Mr. Shaw will be located at the headquarters of the company in this territory at 425 E. Water St., Milwaukee.

HARVEY H. EVANS has been placed in charge of production engineering at the Detroit factory of the Gotfredson Truck Corporation. He was previously connected with the Rapid Motor Truck Co., the Central Gear plant of the General Motors Corporation and the Packard Motor Car Co.

Forthcoming Meetings

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 1, 2 and 3. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foremen's Supply Association. Annual exhibit in connection with the annual convention of the American Railway Tool Foremen's Association, Chicago, Sept. 1, 2 and 3.

Machine Tool Exhibit. Sixth annual exhibition of machine tools at the Mason Laboratory, Yale University, under the auspices of the New Haven Section, A.S.M.E., the mechanical engineering department of the Sheffield Scientific School, and the New Haven Chamber of Commerce, Sept. 7 to 10. Administrative office, New Haven Machine Tool Exhibit, 400 Temple St., New Haven, Conn.

International Railway General Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 7 to 10. William Hall, secretary, 1061 West Wabash Ave., Winona, Minn.

American Society for Steel Treating. Eighth national steel and machine tool exposition, Municipal Pier, Chicago, Sept. 20 to 24. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

Society of Automotive Engineers. Annual production meeting, Hotel Sherman, Chicago, Sept. 21, 22 and 23. John Warner, manager of meetings department, 29 West 39th St., New York.

American Foundrymen's Association. Second international foundrymen's congress, Detroit, Sept. 27 to Oct. 1, under the auspices of the American Foundrymen's Association. R. E. Kennedy, secretary, 909 W. California St., Urbana, Ill.

National Association of Manufacturers. Thirty-second annual meeting, Waldorf-Astoria Hotel, New York, Oct. 5, 6 and 7. George S. Boudinot, secretary, 50 Church St., New York.

American Gear Manufacturers Association. Semi-annual meeting, Briarcliff Lodge, Briarcliff Manor, N. Y., Oct. 14, 15 and 16. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

National Safety Council. Fifteenth annual safety congress, Detroit, Mich., Oct. 25 to 29. A. A. Mowbray, director, 108 East Ohio St., Chicago.

American Welding Society. Eighth annual fall meeting, in conjunction with International Welding and Cutting Exposition, Broadway Auditorium, Buffalo, N. Y., Nov. 16 to 19. Secretary's headquarters, 29 West 39th St., New York City.

The Weekly Price Guide

Rise and Fall of the Market

INDICATIONS of higher prices for foundry iron are not in sight at the present time. Steel quotations hold steadily with a flat rate of $2 per 100 lb. applying on 3-in. shapes and ¾-in. bars at Pittsburgh mills. Plates (¼-in.) continue at $1.90 per 100 lb., f.o.b. mill. Foreign competition has not yet succeeded in bringing about a deviation from the quoted price schedules on domestic steel. Prices of shop materials and supplies fabricated from non-ferrous metals appear to be gaining in firmness. Compared with prices in effect at this time last year, brass rods and solder are higher while the market is a trifle softer in cold-drawn shafting, abrasives, belting, and wiping materials.

(All prices as of Aug. 27)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.19
Northern Basic	20.39
Southern Ohio No. 2	21.39
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	27.37
BIRMINGHAM	
No. 2 Foundry	21.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	22.76
Virginia No. 2	28.67
Basic	21.26
CHICAGO	
No. 2 Foundry local	21.75
No. 2 Foundry, Southern (silicon 2.25@2.75)	25.05
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	19.76
Basic	19.76
Bessemer	19.76

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.25
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.25@2.30	3.89	3.15	3.50
No. 12	2.30@2.35	3.94	3.20	3.55
No. 14	2.35@2.40	3.99	3.25	3.60
No 16	2.45@2.50	4.09	3.35	3.70
Black				
Nos. 18 to 20	2.90@2.95	4.30	3.65	3.90
Nos. 22 to 24	2.95@3.00	4.35	3.70	3.95
Nos. 26 and 27	3.00@3.05	4.40	3.75	4.00
No. 28	3.10@3.15	4.50	3.85	4.10
Galvanized				
No. 10	3.20@3.30	4.65	4.00	4.25
Nos. 12 to 14	3.30@3.40	4.75	4.10	4.35
No. 16	3.45@3.55	4.90	4.25	4.50
Nos. 18 to 20	3.60@3.70	5.05	4.40	4.65
Nos. 22 to 24	3.75@3.85	5.20	4.55	4.80
Nos. 26 and 27	3.90@4.00	5.35	4.70	4.95
No. 28	4.20@4.30	5.65	5.00	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — Decimal	B.W.G. and Fractions	Outside Diameter in Inches — ⅛	¼	⅜	½	1	1¼	1½
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.30	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.10	3.10
Soft steel bars (base)	3.24	3.00	3.00
Soft steel bar shapes (base)	3.24	3.00	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.20	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60%	55%	50%

Electric welding wire, New York, ⅛, 8.35c.; ¼, 7.85c.; ⅛ to ½, 7.35c. per lb. *Flat, ⅛@½-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.62½
Tin, 5-ton lots, New York			67.12½
Lead (up to carlots) E. St. Louis	7.65	New York	9.50
Zinc (up to carlots) E. St. Louis	7.37	New York	8.37½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	19.00	20.50	17.00
Copper sheets, base	23.00	23.00	23.00
Copper wire, base	20.00	20.00	16.50
Copper bars, base	22.62½	22.62½	22.50
Copper tubing, base	25.00	25.00	25.00
Brass sheets, base	19.37½	19.37½	19.37½
Brass tubing, base	24.25	24.25	23.75
Brass rods, base	17.12½	17.12½	17.12½
Brass wire, base	19.87½	19.62½	19.87½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	28.00	27.00	27.02
Zinc sheets (casks)	13.25	12.55	12.01
Solder (½ and ½), (case lots)	41.12½	42.50	38½@42½

Babbitt metal, delivered, New York, cents per lb.:

Genuine, highest grade	82.00
Commercial genuine, intermediate grade	56.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	14.75

Nickel, f.o.b. refinery, cents per lb.:

Ingots	35.00	Electrolytic	39.00
Shot	36.00		

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00

Base price of Monel metal in cents per lb. f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	35.00
Blocks	32.00	Cold drawn rods (base)	43.00
Cold rolled sheets (base)	50.00	Hot rolled sheets (base)	42.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.50 @12.75	11.50	11.25@11.75
Copper, heavy, and wire	11.75 @12.25	11.75	10.75@11.25
Copper, light, and bottoms	10 25 @10.50	10.00	9.50@10 25
Heavy lead	7 50 @ 7.75	7.00	7.00@ 7.50
Tea lead	5.50 @ 6.00	5.00	6.00@ 6.50
Brass, heavy, yellow	7.25 @ 7.50	7.50	7.25@ 7.75
Brass, heavy, red	9.50 @10.00	9.75	9.00@ 9.50
Brass, light	6.12½@ 6.37½	6.00	6.75@ 7.25
No. 1 yellow rod turnings	8.50 @ 8.75	8.00	7.75@ 8.25
Zinc	4.25 @ 4.75	4.50	4.25@ 4.75

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20	9.70	9.90	9 50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.75@8.00	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0. 13@0. 17½	$0.18	$0 15
Cotton waste, colored, per lb.	.10@ .14	.14	.12@.17
Wiping cloths, washed white, per lb	.17½	36.00 per M	15
Sal soda, per 100 lb. keg	2.05	2.25	2.75*
Roll sulphur, per 100 lb	2.70†	3.50	4.25‡
Linseed oil, per gal., 5 bbl. lots	.95½	1.05	.92
Lard cutting oil, 25% lard, per gal.	.55	.50	.48
Machine lubricant, medium-bodied (55 gal. metal bbl.), per gal.	.35	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*Per 175 lb. keg. †In 150-lb. bags. ‡Per 425 lb. barrel.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb	.1712½	.1687½	.1687½
Solder (½ and ½)	per lb.	.4112½	.40	.395
Cotton waste	per lb.	.13@.17½	13@.17½	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	7.00
Emery disks, cloth, No. 1, 6 in. dia.	per 100	3.10	3.55	3.55
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.35	.35	.35
Belting, leather, medium	off list	40–5%	40–5%	40%
Machine bolts, up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.40	$5. 84	$5.65
Emery paper	10. 71	11. 00	10. 71
Emery cloth	27. 84	31. 12	29. 48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1. 32	1. 45	1. 49
Cloth	3. 10	3. 55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		3.50@ 3.65
Coke, prompt foundry, Connellsville	per net ton		4.25@ 5.00
White lead, dry or in oil	100 lb. kegs	New York, 15.25	
Red lead, dry	100 lb. kegs	New York, 15.25	
Red lead, in oil	100 lb. kegs	New York, 16.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x¼-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x¼-in., 2c. each. Discount 70% for $\frac{5}{16}$-in and smaller and 65% for ⅜-in. and larger.
Case hardened ¼x¼-in., 6c. each, less 50%.

Rivets, button heads, ⅜-in., ½-in., 1-in. diam. x 2$\frac{1}{16}$-in. to 4½-in $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{1}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅝-in. dia., 35c.; ¾-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb. 50c.; countersunk heads, 45c.

Washers, cast iron, ⅜-in., $7.00* per 100 lb. at New York warehouses: ½-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

D. C., Washington—A. L. Flint, Genl. Purch. Office, of Panama Canal—will receive bids until September 3, for stocks, dies, reamers, drills, bits, etc.

Mass., Chelsea—J. J. Mann, 12 Third St.—machine lathe 9 in. swing, self feeding.

Mo., St. Louis—Bd. Educ., 911 Locust St.—will receive bids until September 8 for manual training shops equipment, etc., for Vashon School. Estimated cost $100,000.

N. Y., Buffalo—Nash Buffalo Corporation, 25 East Jewett Ave.—small tools and lathe for garage repair shop.

O., Cleveland—J. C. Heintz, 1319 Main Ave.—will receive bids about September 15, for 60 in. boring mill.

Tenn., Chattanooga—Casey-Hedges Co., Vulcan St.—equipment for the manufacture of steel barrels.

Wis., Eau Claire—Bark River Bridge & Culvert Co., Cameron St.—metal culvert working machinery.

Wis., Racine—Standard Foundry Co., 1600 Kewaunee St.—foundry equipment, crane, etc.

Ont., St. Catherine—S. Lee, Bond St.—equipment for garage and repair shop.

Ont., Wiarton—D. S. Sinclair, Berford St.,—complete equipment for foundry and machine shop.

Que., St. Roch de L'Achigan—J. LaFortuna,—complete equipment for blacksmith shop.

Australia, Melbourne—Victorian Government Railway—will receive bids until September 29, for turret lathe including all equipment.

Opportunities for Future Business

Calif., Emeryville — Emeryville Union High School Dist., is having plans prepared for the construction of three 2 story high school buildings, with shops, etc. $200,000 or more. W. H. Weeks, 369 Pine St., San Francisco, Archt.

Calif., Inglewood — Kroehler Mfg. Co., 5111 Santa Fe Ave., Los Angeles is receiving bids for the construction of 3 story, 170 x 200 ft. factory, for manufacture sanitary supplies, at Redondo Blvd. near Damask St. Estimated cost $250,000, N. W. Alpaugh, 2404 West 7th St., Los Angeles, Archt.

Calif., Los Angeles — Chapman Bros., West 6th St., have had preliminary plans prepared for the construction of 6 story, 90 x 275 ft. garage at 16th and Mariposa Sts. Estimated cost $150,000. R. H. Orr, 1305 Corporation Bldg., Archt.

Calif., San Bernardino — R. L. Wainwright, awarded contract for the construction of part 1 and 3 story garage and service station. Estimated cost $165,000.

Calif., San Francisco—California Electric Supply Co., 643 Mission St., is having plans prepared for the construction of 2 story shops building at Folsom and 12th Sts. Estimated cost $55,000. O'Brien Bros., Inc., 315 Montgomery St., Archts.

Calif., Santa Barbara—Santa Barbara High School Dist., will soon award contract for the construction of 1 story high school shop buildings. Estimated cost $100,000. W. H. Weeks, 369 Pine St., San Francisco, Archt.

Conn., New Haven—New Haven Clock Co., 133 Hamilton St. plans the construction of 2 story, 60 x 111 ft., factory, here.

Ill., Decatur—Wabash Railway Co., Railway Exchange Bldg., St. Louis, Mo. will soon receive bids for the construction of 1 story, 50 x 150 ft. addition to reclamation plant, here. Estimated cost $50,000. R. H. Howard, c/o owner, Ch. Engr.

Ind., Fort Wayne—Wayne Tank & Pump Co., B. F. Geyer, Genl. Mgr. is having plans prepared for the construction of 2 story, 62 x 86 ft. factory. Estimated cost $40,000. C. R. Weatherhogg, 250 West Wayne St., Archt.

Ind., Tipton—General Piston Ring Co., is having plans prepared for the construction of 1 story, factory, here. Estimated cost $40,000. L. J. Richards, Bates Bldg., Archt.

Mass., Boston—E. I. Brown, 18 Tremont St. awarded contract for the construction of 1 story, 80 x 200 ft. repair and service garage, on Rhodes St. Estimated cost $40,000. Noted Aug. 12.

Mass., Boston — E. L. Sturtevant, 322 Tappan St., Brookline, having sketches prepared for the construction of 4 story, 160 x 210 ft. garage, at Gainsboro and St. Botolph Sts. Estimated cost $300,000. F. A. Norcross, 46 Cornhill, Archt.

Mass., Cambridge—Lesser & Levine, 43 Holburn St., Roxbury, awarded contract for the construction of 1 story, 175 x 300 x 325 ft. garage at 590 Main St. Estimated cost $150,000.

Mass., Newton—Fessenden School, Albermarle Rd., West Newton, is receiving bids for the construction of 3 story repair and service garage on Albermarle Rd. Estimated cost $40,000. Shepard & Stearns, 65 Franklin St., Boston, Archts.

Mass., Newton—N. H. Turner, 69 Elmwood St. plans the construction of 2 story, garage and repair shop. Estimated cost $50,000. Engineer and architect not selected.

Mass., Roxbury (mail Boston)—H. M. Rittenberg, 12 Garden St., Boston, is having plans prepared for the construction of 1 story 55 x 200 ft. and 30 x 40 ft. store, garage and repair shop, at 2044 Washington St., here. Estimated cost $60,000. S. S. Eisenberg, 46 Cornhill, Boston, Archt.

Mass., Somerville—Winter Realty Co., Inc., 383 Bway., rejected bids and is having revised plans prepared for the construction of 2 story, 100 x 129 ft. repair and service garage, on Bond St. Estimated cost $100,000. Stebbins & Watkins, Federal St., Boston, Archts.

Mass., Watertown—Stuart Marshall Realty Co., 286 Centre St., Newton, is having plans prepared for the construction 1 story repair garage and salesroom, at Maple and Salem Sts. Estimated cost $40,000. S. E. Moffie, 51 Cornhill, Boston, Archt.

Mass., Woburn—J. H. Bates & Co., Inc., 16 Montvale Ave. is having plans prepared for the construction of 1 story repair garage and show room, here. Estimated cost $50,000. C. H. Wood, 36 Arlington Rd. Archt.

Mich., Detroit—Automatic Products Co., 1145 West Grand Blvd., awarded contract for the construction of 1 story, 60 x 150 and 58 x 65 ft. screw products factory, on Bangor St.

Mich., Detroit—Cogsdill Mfg. Co., 6511-15 Epworth Blvd. has work underway on the construction of 35 x 140 ft. addition to plant for manufacture of metal cutting tools. S. A. Cogsdill, Pres.

Mich., Menominee—Bates Valve Bag Co., 8240 Chicago Ave., Chicago, plans the construction of a 82 x 240 ft. factory, here.

Mich., Northville—Detroit House of Correction, Alfred St., awarded contract for group of buildings, including factory, here. $519,750.

N. Y., Buffalo—Nash Buffalo Corporation, 25 East Jewett Ave., plans the construction of 5 story garage, here. Estimated cost $100,000.

N. Y., New York—Bd. Trustees Bellevue & Allied Hospitals, foot East 26th St., awarded contract for the construction of garage at 26th St. and 1st Ave. Estimated cost $94,440.

O., Cleveland—J. C. Heintz, 1319 Main Ave., awarded contract for the construction of 1 story, 48 x 66 ft. machine shop, at 3738 West 143rd St. Estimated cost $40,000.

O., Cleveland—Reliance Electric & Engineering Co., 1088 Ivanhoe Rd., awarded contract for the construction of 2 story 40 x 82 ft. factory addition, at 1088 Ivanhoe Rd. Estimated cost $40,000.

O., Columbus—H. M. Freck, 176 South Pearl St., is having plans prepared 2 story repair and service garage, on Front St. Estimated cost $85,000. R. Stims, 35 East State St., Archt.

O., Fairport—Fairport & Painsville Eastern R.R. Co., Painsville, J. H. McNash, Pres., had plans prepared for the construction of 1 story, 90 x 180 ft. machine shop and round house. Estimated cost $75,000. R. E. Sheal, Union Trust Bldg., Cleveland, O., Archt. and Engr.

Pa., Altoona—Pennsylvania R.R. System, Broad Street Station, Philadelphia, is receiving bids for the construction of 1 story, 20 x 632 ft. tank shop here. Estimated cost $200,000. A. C. Shand, Philadelphia, Ch. Engr.

Pa., Philadelphia — City, Department of Transit, will receive bids until September 16 for the construction of group of shop buildings, including 1 and 2 story 362 x 380 ft. general repair shop, with 38 x 160 ft. wings, for Fern Rock Service Yards, Broad Street Subway. Private plans.

Pa., South Greensburg (mail Greensburg)—Moore Metal Mfg. Co., awarded contract for the construction of 1 story, 100 x 200 ft. plant, on Huff Ave. Estimated cost $50,000.

Tenn., Chattanooga — Casey-Hedges Co., Vulcan St., plans the construction of a 100 x 500 ft. plant for the manufacture of steel barrels.

Wis., Eau Claire—E. J. Hancock, Archt., Lacock Bldg., is receiving bids for the construction of 1 story 62 x 100 ft. factory, on Chippewa Rd., for Bark River Bridge & Culvert Co., Cameron St. Estimated cost $40,000.

Wis., Green Bay—Northwest Engineering Works, Howard St., awarded contract for the construction of 104 x 122 ft. machine room, 50 x 184 ft. receiving room, 44 x 160 ft. erection shop and 20 x 192 ft. stock room, here. Noted Aug. 19.

Wis., Green Bay—Standard Oil Co., 414 Syracuse St., Milwaukee, will soon receive bids for the construction of 1 story machine shop, here. Estimated cost $40,000. R. N. Allen, c/o owner, 910 South Michigan Ave., Chicago, Ill., Archt.

Wis., Milwaukee—Chain Belt Co., 730 Park St., is receiving bids for 1 story, 120 x 308 ft. structural shop at 39th and Orchard Sts. F. D. Chase, Inc., 720 North Michigan Blvd., Chicago, Ill., Engr. Noted Aug. 19.

Wis., Racine—Standard Foundry Co., 1600 Kewaunee St., awarded contract for the construction of 1 story, 112 x 220 ft. foundry. Estimated cost $100,000. Noted July 22.

Ont., St. Catherine—S. Lee, Bond St., plans the construction of 2 story, 100 x 125 ft. brick and steel garage and auto repair shop. Estimated cost $50,000.

Ont., Wiarton—D. S. Sinclair, Berford St. plans the construction of a foundry and machine shop, here. Estimated cost $25,000.

Ont., Windsor—Canadian National Rys. Montreal, Que., having plans prepared for the constructing of roundhouse, machine shop and enlarging yards, here. $250,000. C. S. Gzowski, Ch. Constr. Engr.